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Recent Observations of Air Temperature and Snow Depth in the Mackenzie Valley Area and their Implications on the Stability of Permafrost Layers

by

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and

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ATMOSPHERIC ENVIRONMENT SERVICE

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RECENT OBSERVATIONS OF AIR TEMPERATURE AND SNOW DEPTH IN THE MACKENZIE VALLEY AREA AND THEIR IMPLICATIONS ON THE STABILITY OF PERMAFROST LAYERS

ABSTRACT

The objective of this study was to review atmospheric climate changes in the Mackenzie Valley which are of relevance to the stability of permafrost layers in that region. Changes since 1970 were of particular importance since the most recent work on the climatology of the Mackenzie Valley analysed data only up to this date. This study was restricted to a review of air temperature, snow depth and the frost index, which is a measure of the probable presence of permafrost due to climate affects.

Temperature observations have been made at several stations along the Mackenzie River for 50-90 years, while snow depth observations are available for the past 30 years. Only those temperature and snow depth observations which are available in computer files were analysed, which limited the study to the post-1940 period. While a few stations have data gaps and discontinuities due to the station being moved, these problems are not considered serious - particularly in the post-1970 period which is the focus of this work. However, temperature and snow depth are known to vary considerably as one moves away from the valley floor into higher elevations, and there are virtually no observations at these higher elevations in the Mackenzie Valley area. This is a major shortcoming of the data base and significantly restricts the applicability of the analysis contained herein.

Long term records of 10 year running mean monthly and annual temperatures in the Mackenzie Valley have displayed an oscillatory behaviour since 1900 with increases or decreases over a ten year period of 2-4 °C with local minimums occurring around 1970. Since 1970, a warming trend of between 0.4 and 0.5 °C per year for January temperatures has been sufficient to completely reverse cooling trends observed in this area in the sixties. For the entire post-1940 period, which includes several warming and cooling intervals, a small but significant warming was observed at many stations. An analysis of upper air data showed that the warming observed at the surface extended to at least the 85 KPa level, but that the frequency of inversions has not changed greatly since 1961.

Snow depth was highly variable with airport observations often being quite different from snow course values less than 1 km away. Discrepancies were most noticeable since 1980 at Norman Wells. Using airport values, a trend to decreasing snow depths was observed since 1970 for most stations in the Mackenzie Valley.

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Frost index includes the effects of warming temperatures and the opposite effects of thinning snow depths on the probable presence of permafrost. For most stations, the effects of warming temperatures were decisive, and the stability of permafrost was estimated to have declined since 1970. For Norman Wells, however, thinning snow depths were decisive and the opposite conclusion was reached.

Independent tests on the accuracy of the thermal damping depth of snow were carried out with data from Canyon Creek near Norman Wells. These tests supported the original estimation procedure described in Stuart (1986) for stations in the Mackenzie Valley.

Tests on the applicability of upper air data in the estimation of elevated surface temperatures were carried out for Canyon Creek surface data and Norman Wells upper air data. The time series of observations was too short to permit final conclusions to be reached, but for the limited time series available, upper air data were seen to have little value in the estimation of surface temperatures up to 100 m above the elevation of the upper air station.

MESURES RÉCENTES DE LA TEMPÉRATURE DE L'AIR ET DE L'ÉPAISSEUR DE LA COUVERTURE DE NEIGE DANS LA VALLÉE DU MACKENZIE ET DE LEURS EFFETS SUR LA STABILITÉ DU PERGÉLISOL

RÉSUMÉ

L'étude dont il est ici question avait pour objet d'examiner les changements de climat pouvant influer sur la stabilité du pergélisol dans la vallée du Mackenzie. Les changements intervenus depuis 1970 sont particulièrement importants étant donné que les travaux les plus récents d'analyse climatique relatifs à cette région ne remontaient qu'à cette année-là. Les travaux qui nous occupent se limitaient à l'examen de données sur la température de l'air et l'épaisseur de neige ainsi que de l'indice de gel, qui indique l'existence probable du pergélisol à cause de facteurs climatiques.

On effectue des mesures de la température à plusieurs stations le long du fleuve Mackenzie depuis 50 à 90 ans. Les mesures de l'épaisseur de la couverture de neige, quant à elles, ont commencé il y a 30 ans. On a analysé seulement les valeurs de température et de hauteur de neige qui se trouvaient dans les fichiers informatiques, à savoir pour la période commençant en 1940. Le déplacement de stations a entraîné quelques absences de données ça et là dans les archives, mais cela n'a pas causé de problèmes graves, en particulier pendant la période visée par l'étude, soit de 1970 jusqu'à présent. Toutefois, on sait que les valeurs de la température et de l'épaisseur de neige varient considérablement à mesure que l'élévation augmente et il ne s'est fait presque pas fait d'observations météorologiques en terrain élevé dans la vallée du Mackenzie. Il s'agit d'une importante lacune de la base de données qui limite l'utilité de l'analyse faisant l'objet du présent résumé.

Les moyennes mensuelles et annuelles des températures sur dix ans dans la vallée du Mackenzie oscillent depuis 1900 : on observe des hausses ou des baisses de ces moyennes de 2 à 4 degrés Celsius sur dix ans et les valeurs minimales ont été mesurées vers 1970. Depuis 1970, la température moyenne en janvier augmente de 0,4 à 0,5 degré d'une année à l'autre, ce qui est suffisant pour contrebalancer complètement les baisses mesurées dans la région au cours des années 1960. On a observé un réchauffement, faible mais significatif, à de nombreuses stations entre 1940 et aujourd'hui, période marquée par plusieurs épisodes de réchauffement et de refroidissement. Une analyse de données aérologiques a révélé que le réchauffement observé à la surface se faisait sentir en altitude jusqu'au niveau de 85 kPa, mais que la fréquence des inversions n'a pas varié beaucoup depuis 1961.

Les valeurs de l'épaisseur de la neige étaient très variables : celles mesurées aux aérodromes étaient souvent très différentes de celles mesurées dans des parcours de relevés d'enneigement situés à moins d'un kilomètre de distance. Les écarts sont très marqués depuis 1980 à Norman Wells. Si l'on considère les valeurs mesurées aux aérodromes, il y a une tendance à la baisse de l'épaisseur de la couverture de neige depuis 1970 à la plupart des stations de la vallée du Mackenzie.

L'indice de gel permet de déterminer l'existence probable du pergélisol compte tenu des effets de la hausse des températures et des effets opposés de l'amincissement de la couche de neige. À la plupart des stations, les incidences de cette hausse ont été décisives : selon les estimations, la stabilité du pergélisol aurait diminué depuis 1970. En revanche, à Norman Wells, la couche de neige s'est amincie de sorte que l'inverse s'est produit.

À partir de données recueillies à Canyon Creek, près de Normal Wells, on a mené des expériences indépendantes visant à contrôler l'exactitude des estimations de l'atténuation des variations thermiques dans l'atmosphère par la couverture de neige. Les résultats confirment la validité des méthodes d'estimation originales décrites par Stuart (1986) pour les stations de la vallée du Mackenzie.

De plus, on a déterminé si les données aérologiques (recueillies à Norman Wells) pouvaient servir à estimer l'effet de la hausse des températures en surface (à Canyon Creek). La série chronologique des observations, bien que trop courte pour qu'on puisse tirer des conclusions définitives, a révélé que les données aérologiques sont peu utiles pour l'estimation de la température de l'air depuis la surface jusqu'à 100 mètres d'altitude au-dessus de la station aérologique.

EXECUTIVE SUMMARY

The principal objective of this study was to examine existing climate data bases to determine the extent of any changes in climate parameters of importance to permafrost regimes in the Mackenzie Valley area. Observations made after 1970 were of particular importance since the last study on the climate of this region (Burns, 1973) analyzed observations only up to this date.

Virtually all climate observations in the Mackenzie Valley were made near the shores of the Mackenzie River, and very little information is available from higher elevations. Extrapolation procedures in which conditions at these higher elevations were inferred from observations near the River were shown to have little skill, and as a result, observing programs that are specifically targetted to sensitive permafrost areas will be required to support any planning strategies for these areas. Higher elevation observing stations should provide daily observations of air temperature, precipitation amount, wind speed and snow depth. If general relationships on the variability of air temperature and snow depth with elevation for the Mackenzie Valley area are required, then a grid of observing stations at various elevations and surrounding A.E.S. upper air stations at the valley floor should be established. Observations made at these stations should then be compared with results from existing programs in which a high degree of spatial resolution in hilly terrain has been achieved.

An analysis of existing AES observing stations showed that January and mean annual temperatures have generally increased, both since 1940 and since 1970. These increases are often significantly larger than might have resulted from random year to year variations. An analysis of upper air data showed that these warming trends extend beyond 1000 m are not restricted to the lowest layers of the atmosphere. Accordingly, these trends cannot be explained by increasing industrial development along the Mackenzie River during this period of time.

End of month snow cover depths at AES stations were also examined for the available period of record, and showed a high year to year variability. When trends over time were detected they tended to indicate a decrease in snow depth since 1970. A comparison of A.E.S. airport and nearby snow course observations showed significant differences since 1980 that cannot be explained without further analysis. Apparently, the applicability of snow cover data is restricted to the immediate area where the observation was made; large variations from these observations may be expected only 1 km away or less. This further supports the contention that any conclusions made for sensitive permafrost regimes must be supported by observing programs specifically targetted to the geographic areas in question.

The frost index model developed by Stuart (1986) was applied to the temperature and snow depth observations in the Mackenzie Valley, and generally showed lower values over the past 17 years. This is equivalent to an expected warming of the soil and a subsequent decrease in the probability of permafrost occurrence. A comparison of estimates of the thermal damping depth of snow derived from Mackenzie

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Mean daily soil temperature (0.5 m depth) < 0 degrees C
Mean daily snow depth < 50 cm.
For this scattergram the independent variable (X axis) is the natural logarithm of the ratio of air and soil temperatures, and the dependent variable (Y axis) is the snow depth in cm.

Figure 4.10: Scattergram and best linear fit to all Canyon Creek daily data meeting the following requirements:
Mean daily air temperature < -5 degrees C
Mean daily soil temperature (0.5 m depth) < 0 degrees C
Mean daily snow depth < 50 cm.
For this scattergram the independent variable (X axis) is the product of natural logarithm of the ratio of air and soil temperatures and the square root of the snow density (g cm^{-3}), and the dependent variable (Y axis) is the snow depth in cm. Also shown is the best-fit straight line required to pass through the origin.

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RECENT OBSERVATIONS OF AIR TEMPERATURE AND SNOW DEPTH IN THE MACKENZIE VALLEY AREA AND THEIR IMPLICATIONS ON THE STABILITY OF PERMAFROST LAYERS

1. INTRODUCTION

Permafrost is a temperature condition of the Earth, and is defined to exist whenever soil temperatures are below freezing for a period of two years or more. The existence of permafrost as well as its thickness and geographical extent depend strongly on mean annual air temperature and snow cover. Air and soil temperatures are related through a variety of heat transfer mechanisms, while snow tends to insulate the ground from colder winter time temperatures. Changes in these climatological parameters, whether due to their inherent natural variability or to anthropogenic causes such as the enhanced Greenhouse Effect, will have a direct and measurable impact on permafrost characteristics. Since these characteristics have important implications for a wide variety of northern activities and installations, it is essential that climate change and variability be understood, and the consequent implications on permafrost regimes be anticipated and accounted for in northern development projects.

Smith (1988) has recently reviewed the expected impact of the enhanced Greenhouse Effect on permafrost layers. Because of increasing atmospheric concentrations of carbon-dioxide and other radiatively active gasses, air temperature in polar regions is expected to increase dramatically in the next several decades, and precipitation is expected to increase as well. Should these atmospheric changes occur, geologists predict that tens of thousands of square kilometres of permafrost will eventually disappear. Even in the short term, the deepening active layer will result in severe maintenance and repair problems for all kinds of surface structures in the north. It should be emphasized that any attempts to plan for these anticipated changes will be hampered by uncertainties of at least two kinds: (1) The relationship between the build-up of greenhouse gases and changes in climate is extremely complex, and reliable predictions of new temperature and snow depth values for specific construction sites cannot be made at the present time; and (2) Even if new values of air temperature and snow depth were known, the relationship between atmospheric and soil conditions is further complicated by soil characteristics, surface vegetation and their relationship to climate, and a host of other factors which depend on characteristics unique to the specific location in question. Consequently, any predictions must contain large uncertainties when applied to specific planning projects.

While climate change due to the Greenhouse Effect is an important, high profile issue at the present time, it should not be forgotten that climatic parameters such as air temperature and snow depth are always subject to large, natural variations from their present climatic mean values. Year-to-year variations are well known and expected, but changes are also observed over time scales of decades, centuries and longer. Direct studies of these natural variations and their resultant impact on ground temperatures can be made only in locations with a sufficiently long time-series of relevant observations. Direct

observations preclude the necessity of model runs, and avoid inevitable modelling errors. Also, an analysis of actual observations can be helpful in the design and calibration of models and the reduction of such errors. In the Mackenzie Valley area, such direct studies are limited to decadal changes since observational programs have been in existence for less than 100 years.

Studies of climate variations over time scales that are longer than any existing weather records have also been carried out for the Canadian Arctic by workers from a variety of disciplines. Oxygen isotope analysis of layered ice cores is used to infer air temperature over geologic time scales of 10,000 years or more. The relative concentration of ^{18}O in precipitation is determined by the temperature at which it formed with lower concentrations of this isotope occurring at colder temperatures (Dansgaard et al, 1969). Hooke and Clausen (1982), for example, inferred a temperature change of 15 Celsius degrees through an analysis of the Barnes ice cap on Baffin Island.

Tree ring analysis can be used to detect year-to-year variations prior to the existence of direct observations. Jacoby and Cook (1981) examined a 400 year old white spruce from the north-central Yukon area, and were able to infer wind direction, relative temperatures, pressures and the presence of cloud on a year-to-year basis.

Studies of fossilized pollen samples are used in a large number of studies to infer the state of past climates. Terasmae (1968) examined pollen diagrams from the Chapman Lake area of the Yukon and Bathurst Inlet, N.W.T. to arrive at the following conclusions: In the period 10,000 - 7000 B.P. the replacement of grass sedge tundra by birch, alder and willow is suggestive of a warming trend; a rise of spruce and alder pollen from 7000 - 5000 B.P. indicates a climate which is warmer than current conditions; an alder maximum in the period 5000 - 2000 B.P. suggests increased moisture and the beginning of a temperature decline; the decline of alder and the increase of spruce from 2000 - 1000 B.P. is indicative of drier conditions; colder temperatures and increasing moisture are inferred in the period 1000 - 400 B.P.; and a warming trend is observed in the past 300 years. A large number of other studies using pollen to infer past climate are described in Acres Consulting Services (1986).

Studies of the sediment on the ocean floor and the marine fossils contained therein enable conclusions to be drawn concerning the thickness and continuity of the ice cover on the Arctic Ocean. Miller (1976), for example, examined shell collections from the period 10,000 - 8400 B.P., and concluded that Arctic glaciations are controlled mainly by precipitation, with the most extensive advances made in this period being characterized by warmer seas, temperatures warmer than present values and the increased advection of warm, moist southerly air masses into the region.

It is also possible to infer past climate conditions by studying buried peat masses. Peat is accumulated in a permafrost free environment, and most formations were deposited in the relatively warm

period between 8000 - 4000 B.P. Terasmae (1959) examined buried peat deposits from the Mackenzie Valley area, and concluded that the presence of tamarack cone and spruce pollen suggested more favourable climates during this period than exist today.

Archaeological studies of prehistoric human habitations are also used to examine climate change. Cooling temperatures and deteriorating conditions are accompanied by the abandonment of habitation sites, while the expansion of these sites would indicate an abundance of animals and plants. A review of such archaeological studies is contained in Barry et al (1977).

When the results of all of these studies are taken together the past climate in the District of Mackenzie is reconstructed in the following way (Acres Consulting Services, 1986): The early Holocene period (10,000 - 4000 B.P.) was warmer than at present, with the mean summer position of the Arctic front about 350 km north of its current position. Mean annual temperatures were about 11°C warmer than is the case today, annual precipitation was greater by about 21.5 cm, and potential evapotranspiration was higher by 13 cm. (Delorme et al, 1977; Delorme and Zoltai, 1975). Summer time temperatures were about 5°C higher than at present and the growing season was 30 days longer (Ritchie and Hare, 1971, Ritchie, 1977). Around 4000 B.P. a cooling trend to current conditions was begun.

Actual weather observations have been made in the Mackenzie Valley area for approximately 100 years. Observations made before 1970 have been analyzed by Burns (1973), who found that in the period for which these observations were available, considerable variation has occurred. An increase of about 3°C in the mean January temperature was observed from 1920-1930 with a 2°C drop in the following decade. By the late 1940's an increase of 4°C was observed, followed by a corresponding decrease by the late 1950's. A 3°C rise was noted by the mid sixties followed by a 3°C decrease by 1970 when the Burns study was completed.

This report reviews changes in the Mackenzie Valley climate since 1970, but unlike Burns' original study, this work is limited to those weather elements that most directly affect soil temperatures - air temperature and snow depth. Since most of the observing stations lie in the Mackenzie Valley close to the river, it will also be necessary to examine available upper air temperatures to estimate changes to permafrost regimes in the mountainous areas beyond the river valley.

An examination of the available data base of temperature and snow depth observations and the location of the three available upper air data stations are contained in the following chapter. Analysis procedures are defined in Chapter 2 and results are presented for both surface and upper air data. In Chapter 3, an analysis of temperature and snow depth time-series is carried out, with particular emphasis on the statistical significance of these trends if any. These results are then incorporated into a frost index model developed in a previous work (Stuart, 1986) and results are discussed in Chapter 4 for as many surface stations in the area as possible. Also in Chapter 4 a revised estimate of the thermal damping length of snow is derived from data

obtained by the Geological Survey of Canada at Canyon Creek in the Norman Wells area, and compared with the original estimate of Stuart (1986). In Chapter 5, air temperature and snow depth measurements from this data base are then directly compared with simultaneous measurements made at Norman Wells in an effort to test the applicability of upper air temperature profiles in the estimation of higher elevation surface temperatures. Chapter 6 concludes the study.

2 RECENT AIR TEMPERATURE AND SNOW DEPTH NORMALS IN THE MACKENZIE VALLEY

2.1 GEOGRAPHICAL SCOPE OF THE STUDY

The geographical area of interest in this study is shown in Figure 2.1. It extends from the northern Alberta towns of High Level and Fort Chipewyan in the south to include the entire Mackenzie Valley. The area is bounded by the Yukon border on the west, but since virtually all observing stations are located on the rivers in the area and on Great Slave Lake, the actual area of study is limited to the locations of these stations.

The study area is divided in three sections: (1) The Norman Wells area, which extends along the Mackenzie River from Wrigley to Fort Good Hope; (2) The Mackenzie Delta which includes all stations from Arctic Red River and Fort McPherson to the Arctic Ocean; and (3) The Upper Mackenzie Valley which includes the Alberta stations, the Great Slave Lake area, the Liard River and the Mackenzie River up to Fort Simpson.

2.2 AVAILABILITY OF DATA

This study is limited to climate data existing in the AES computer data base. Observations along the Mackenzie River were made as early as 1900 at some locations, but because Burns' study is based on the 30 year period beginning in 1940, our analysis is based only on observations made after this date.

A review of the AES climate archives indicated that 54 observing stations were located within the geographical boundaries specified for this study. However, these stations are not well distributed within the area and very large areas exist for which no observations are available. The lack of observing stations outside the river valleys and the area around Great Slave Lake has already been mentioned, and this will prove to be a major problem in extending the results from the valley into the surrounding hills and mountainous areas.

In addition to the geographical limitations posed by the data base, other problems associated with the length of the time-series were also encountered. Any attempt to compare climatological records before and after 1970 will obviously require an extensive data base both before and after this date. This requirement turns out to be one that few stations in the Mackenzie Valley area satisfy. For example, only 9 of the original 54 stations have January temperatures and snow depth values for at least 11 years before and after 1970.

Upper air data are observed at only three stations in the Mackenzie Valley area - Fort Smith, Norman Wells and Inuvik. The computer archive of the AES data base extends back to 1961 for Norman Wells and Inuvik and to 1968 for Fort Smith. Accordingly, only the two former stations will be useful for pre-1970 conditions.

2.3 DATA ANALYSIS PROCEDURES

2.3.1 Surface Stations

All available end of month snow depth values for each AES observing station in the study area were obtained from the climate archive. For each month the average end of month value, standard deviation and number of observations were calculated for each month using all years in the data set and these parameters were then recalculated for all years following 1970 - the time period after the Burns (1973) analyses were completed.

All available total monthly precipitation values for each AES observing station in the study area were obtained from the climate archive. For each month the average value, standard deviation and number of observations were calculated for each month using all years in the data set and these parameters were then recalculated for all years following 1970.

All available mean monthly temperatures for each AES observing station in the study area were obtained from the climate archive. For each month the average value, standard deviation and number of observations were calculated using all years in the data set and these parameters were then recalculated for all years following 1970.

2.3.2 Upper Air Stations

All available upper air observations of pressure, height above sea level and air temperature were obtained from the AES archive for Inuvik (latitude 68° 18'N, longitude 133° 29'W), Norman Wells (latitude 65° 17'N, longitude 126° 48' W), and Fort Smith (latitude 60°N, longitude 111° 57'W). Daily ascents were made at 00Z and 12Z.

In the upper air archive each record contains a series of observations made during a single ascent. The pressure record lists a series of decreasing atmospheric pressures made as the balloon ascends in the atmosphere while the height record lists corresponding balloon altitudes and the temperature record lists temperature observations made at each observing level. The observing levels themselves are a subset of the observations actually made and are of two types: (1) certain "standard" levels (e.g., surface, 100 KPa, 85 KPa, 70 KPa, 50 KPa, etc.) which are always included in the record; and (2) a variable number of "significant" levels which are also included. Significant levels could indicate the entry or exit from cloud, the presence of strong wind gradients or the change in the temperature gradient. For our purposes it will be sufficient to think of significant levels as those observations that must be inserted between standard levels to ensure that a linear interpolation of the temperature profile from one

level of the archive record to the next accurately portrays all the temperature data observed during the ascent but omitted in the official archive.

The following parameters were required from the upper air data archive: surface temperature, 85 KPa temperature, surface - 85 KPa mean temperature gradient, near surface temperature gradient, number of ascents with a surface temperature inversion, number of ascents with an upper air inversion and number of ascents with no inversion. These procedures for the calculation of these parameters are now described.

Since each ascent usually contained temperature observations at the surface and at 85 KPa these values are immediately available for analysis. If the height at 85 KPa is also available then the surface to 85 KPa temperature gradient may also be immediately derived from the archive data; if the height value is missing, it may be estimated by a procedure which is described subsequently.

The calculation of the near surface temperature gradient was not straight forward since the first observation above the surface could occur less than 10 metres from the surface or it could be at an elevation several hundred metres above the surface elevation. For example, if the surface pressure was greater than 100 KPa then the temperature at 100 KPa would always be given since 100 KPa is a standard level. In such cases the 100 KPa level would usually occur only a few metres above the surface, and the accuracy of the on-board thermometer would be insufficient to properly estimate the thermal gradient in this very thin layer. On the other hand, if the surface pressure were less than 100 KPa the profile would have no 100 KPa level, and the first level above the surface could be at a widely variable elevation. To establish a uniform procedure for the calculation of the near surface temperature gradient the surface temperature was compared with the temperature at 100 m above the surface. This temperature was obtained through a linear interpolation involving the nearest levels below and above the pre-set 100 m height level. Since the selection of significant levels is made to ensure that interpolations of this nature are accurate, the procedure was expected to provide a good approximation of the temperature gradient in the first 100 m above the surface for all ascents in all seasons.

The lack of uniformity in near surface observation levels also affects the procedure for determining the presence or absence of surface inversions. For example, if one simply examined the surface temperature and the first elevated temperature observation the thickness of the layer might be too small for the sign of the gradient to be determined accurately. Accordingly, for this study such temperature gradients were not used to determine the presence or absence of inversions. Instead, all temperature profiles were placed in one of the following three categories: (1) A surface inversion was assumed to exist if the temperature at 100 m as estimated above is greater than or equal to the surface temperature; (2) An upper level inversion was assumed to exist if the 100 m temperature is less than the surface temperature and if the surface temperature is not the warmest temperature observed during the ascent; and (3) No inversion is assumed

to exist if the surface temperature is the warmest temperature observed during the ascent. It will be noted that all temperature profiles will satisfy exactly one of these conditions.

It was frequently the case that the one or more height estimates during the ascent was missing in the official archive. When this occurred the missing value can usually be estimated from the hydrostatic equation:

$$\Delta\varphi = -R_d \int T_v d\ln p \qquad (2.1)$$

where φ is the change in geopotential height, R_d is the gas constant for dry air, T_v is the virtual temperature and p is the air pressure. For the purposes of this study, we may assume that $\Delta\varphi = g\Delta z$ where g is the acceleration of gravity, and we may neglect the effect of water vapour by assuming that $T_v = T$.

Under these assumptions Equation 2.1 can be shown to be equivalent to:

$$Z = Z_1 - R_d(\ln p - \ln p_1)(T + T_1)\ /2g \qquad (2.2)$$

where Z_1, P_1, and T_1 are the height, pressure and temperature values for the level just below the level where Z is required and P and T are the pressure and temperature values at the level in question.

In this work the hydrostatic equation was used with surface conditions to estimate the height at the first level, and was subsequently used in repetitive fashion to estimate the height of all higher levels. Estimates made in this way were usually within a few meters of the observations recorded in the archive. Then to achieve consistency, all temperature gradients were calculated from heights which were derived from the hydrostatic approximation.

2.4 RESULTS FOR THE SURFACE STATIONS

2.4.1 Temperature

Burns'(1973) maps for mean daily temperature are based on the 30 year period 1941-70. For this study we present maps of mean January, April, July and October surface temperature values for the 1941-70 period as well as the variation from this mean observed during the 17 year period 1971-87. No attempt has been made to estimate temperatures between stations, since the methods of interpolation used by Burns (1973) may not be accurate (see Chapter 5). It should also be noted that the temperature differences indicated on the following maps may or may not be significant in the statistical sense. Further analyses on

temperature time trends (Chapter 3) including the natural year-to-year variation, and number of observations before and after 1970 will address this issue.

January mean monthly temperatures are shown in Figure 2.2. In the Mackenzie delta area, a general warming of less than 1°C is observed at coastal stations which increases to almost 2°C at Inuvik and Aklavik, with a very small cooling at Fort McPherson. South of the delta, most stations indicate a warming of 2-3°C with Fort Good Hope (1.2°C) and Fort Norman (4.7°C) on either side of this range. Around Great Slave Lake, all stations indicate warmer temperatures in January with increases between 0.4°C (Fort Providence) and 2.6°C (Fort Smith A).

The April map of mean temperatures (figure 2.3) generally shows cooler temperatures in the north and warmer temperatures in the south since 1970. In the Mackenzie delta area, all stations indicate cooler temperatures in April with magnitudes between 0.1°C at Inuvik A to 1.6°C at Shingle Point A. This result contrasts sharply with stations in the Great Slave Lake area where all stations show a warming of 2°C or more except Fort Providence (1.1 C). In the intermediate Norman Wells area both cooling and warming shifts in the mean April temperature are observed, but all variations from 1941-70 normals are less than 0.5°C.

The July mean temperature map (figure 2.4) shows that no station's mean monthly value in the post-70 period has changed by more than 1°C from its 1941- 70 normal. In the north and central areas, all stations indicate a warming trend, with increases of 0.5°C or less in the delta and values closer to 1°C in the Norman Wells area. In the Great Slave Lake area, both cooling and warming trends are indicated.

Figure 2.5 shows that in October, post-1970 temperatures generally show some cooling compared with the previous 30 year period. In the Mackenzie delta and Norman Wells areas, mean monthly temperatures have fallen by 1-2°C while in the Great Slave Lake area, departures from 1941-70 mean values are always less than 1°C, and at Fort Providence a 0.3°C warming is observed.

It should be noted that, while the differences noted above may indicate significant warming or cooling trends in the past 17 years, they may also be artifacts of the natural year-to-year variation or they may suffer from a lack of observations. For example, the unusually low January warming noted at Fort Providence may be due to the fact that only 4 mean monthly values were available in the post-71 period.

A complete listing of temperature statistics for all available stations is given in Appendix 1. Included for each month and each station are the number of years of data, the mean value and standard deviation for the entire data base and for the post-1970 data base.

2.4.2 Snow Depth

Average monthly precipitation amounts are available at a large number of stations in the study area, as will be evident from a review of Appendix 1. However, snow depth rather than precipitation is the decisive parameter in the development or erosion of permafrost layers, and the connection between precipitation amounts and snow depth, even during the coldest months, is at best tenuous (Stuart, 1986). Accordingly, it was decided at the outset of this work to examine snow depth rather than precipitation, despite the fact that snow depth is measured at far fewer stations.

Post-1970 snow depth observations were available at 22 stations in the study area, and 15 of these stations had sufficient observations prior to 1970 to make a comparison meaningful. In his report Burns provides maps of snow depths in the Mackenzie Valley area on the last day of every month in the winter season. In this report, we will limit our investigation to average snow depths on the last days of November, January and March. These maps are reproduced herein as figures 2.6a, 2.7a and 2.8a. Pre- and post-1970 station data are shown on figures 2.6b, 2.7b and 2.8b.

Snow depths at the end of November (figure 2.6) in the post-70 period show increases in the Mackenzie delta area, decreases around Norman Wells and both increases and decreases around Great Slave Lake. The anomously high snow depths before 1970 and correspondingly large decreases after that date at Fort McPherson and High Level A can be attributed to a small number of observations before and/or after 1970.

Figure 2.7, snow depth values on January 31, shows decreasing or marginally increasing values throughout the Mackenzie Valley region. In the delta area, little change is noted, while around Norman Wells and Great Slave Lake, snow depth have dropped by between 10 and 30 per cent.

On March 31 (figure 2.8), post-70 snow depth averages tend to be lower and often considerably lower than average values observed previous to 1970. As previously noted, the anamologous values at High Level A and Fort McPherson are probably due to the small number of years in which observations were made, but the decreases at Norman Wells A and elsewhere are not so easily dismissed. Further examination of these results is certainly in order, and is presented in Chapter 3.

2.5 RESULTS FOR THE UPPER AIR STATIONS

2.5.1 Inversion Climatology

Monthly statistics for all upper air data are given in Appendix 2. For each of the three stations and two ascent times, the number of observations, mean value and standard deviation are given for surface

temperature, 85 KPa temperature, near surface temperature gradient, surface to 85 KPa temperature gradient, and the percentage occurrence of surface inversions, upper inversions and no inversion. Since the time-series of the stations begins in 1961 (Inuvik and Norman Wells) and 1968 (Fort Smith), no attempt was made to analyse pre-1970 observations since insufficient data were available for this purpose.

The review of upper air data by Burns for the Mackenzie Valley is limited to only 10 years of data (1951-60), all of which was collected prior to the observations available for this work. Also, since his objective was to characterize the entire depth of the atmosphere and ours is to examine the layer below 85 KPa, a detailed comparison of his results and ours was not considered worthwhile for this report.

Upper air data have significance on soil temperatures to the extent that upper air temperatures are related to surface conditions at higher altitude locations in the vicinity of the upper air station. An increase in the number or intensity of surface based inversions in winter at Norman Wells, for example, might well affect soil temperatures in the nearby mountain areas. In the development of his temperature maps, which are reproduced herein as Figures 2.9 - 2.13, Burns assumed that mean upper air temperatures at a given elevation were equal to surface temperatures at the same elevations. This assumption will be examined in greater detail in this report. (See Chapter 5)

In order to observe the greatest variety of near-surface temperature profiles, one of the two daily observation times should occur in mid- to late afternoon when maximum heating at the surface occurs, and the second should occur at night when the nocturnal inversion is strongest. Unfortunately, the far northerly location of these stations greatly restricts the times when these ideal conditions are even approximated.

At Inuvik 00Z occurs approximately one hour after sunset in winter, six hours before sunset in spring, more than nine hours before sunset in summer and two hours before sunset in autumn, while 12Z occurs more than nine hours before sunrise in winter, two hours before sunrise in spring, four hours after sunrise in summer and five hours before sunrise in autumn. In winter then, both ascents are made at night and in summer both ascents are made during the daylight hours. In spring and autumn 00Z occurs during the daylight hours and 12Z occurs at night.

The monthly inversion climatology at Inuvik is shown in Figure 2.14. The similarity of results at 00Z and 12Z in winter is apparent, but the summer months show the diurnal effects of the spring and autumn despite the fact that the sun is up during both observation times. The decreasing frequency of nocturnal inversions as one moves from summer into the autumn is observed at all three stations, and may be explained through increasing instances of mechanical mixing in the windy autumn months.

At Norman Wells both 00Z and 12Z ascents in winter occur between sunset and sunrise, but the 00Z ascent is only a few minutes after sunset. In summer both ascents occur between sunrise and sunset, but the 12Z ascent only one hour after sunrise when one might expect night conditions to at least approximately prevail. As was the case with Inuvik spring and autumn are much closer to the ascent times required to observe both fully developed convection and the nocturnal inversion. In spring, 00Z occurs five hours before sunset and 12Z occurs 1.5 hours before sunrise. Likewise, in the autumn 00Z occurs two hours before sunset and 12Z occurs four hours before sunrise.

Figures 2.15 chart the inversion climatology at Norman Wells. As expected, the 00Z occurrence of inversions in spring is higher at the Inuvik station because of its more northerly location, but this does not occur in the autumn. At 12Z, the nocturnal conditions are very similar to the observations at Inuvik.

The location of the sun at 00Z and 12Z at Fort Smith is approximately the same as Norman Wells. In winter 00Z occurs a few minutes after sunset, while 12Z occurs five hours before sunrise; in summer 00Z occurs five hours before sunset and 12Z occurs one hour after sunrise; in spring, 00Z occurs 3.5 hours before sunset and 12Z occurs one hour before sunrise; and in autumn 00Z occurs one hour before sunset and 12Z occurs three hours before sunrise.

Inversion statistics are shown for Fort Smith in Figures 2.16. The expected decrease in inversion frequency at 00Z compared with Norman Wells and Inuvik is clearly evident in both spring and autumn. As with the other stations, however, night time inversion frequency is lowest in mid- to late autumn and not in the summer as one might expect purely from heat flux considerations.

2.5.2 Air Temperature and Temperature Gradient

Mean monthly temperatures at 00Z and 12Z are shown for the three upper air stations in Figures 2.17 - 2.19. A comparison of these figures shows that the mean temperature at 85 KPa exceeds the surface temperature for about 4.5 months for 00Z ascents and for 6 months for the 12Z ascents at Inuvik. At Norman Wells these times are reduced to 3.5 and 5.5 months respectively, and at Fort Smith, a further reduction to 2.5 and 4.5 months is observed. These conclusions of course, refer to mean temperatures only, and do not imply that these are the only times when inversions may be observed.

Summer heating at the surface results in mean temperatures at 85 KPa that are 10-12°C cooler than surface values at 00Z and 2-4°C cooler at 12Z, with very little difference observed from one station to the other. In winter, however, the degree of cooling at the surface varies considerably between the three stations with mean temperature differences of 8-10°C at Norman Wells and Inuvik and 6-8°C at Fort Smith. Further examination shows that these differences are mainly due to the cooling surface temperatures as one moves north.

Mean monthly temperature gradients are shown in Figures 2.20 - 2.22. In each figure the mean lapse rate in the first 100 m is shown along with the average gradient between the surface and the 85 KPa level. The dry adiabatic lapse rate is also shown on each figure; theoretically, lapse rates less than this value are unstable and cannot be maintained. In practice, however, temperature gradients less than the adiabatic value are frequently observed in the upper air data.

2.6 CONCLUSIONS

Although many surface observing stations exist in the Mackenzie Valley study area, most have not been in operation long enough to permit a comparison of either mean air temperature values or snow depths during the periods before and after 1970. Those stations that do have a sufficiently long data record to permit such a comparison show in general that a warming trend has existed in the Mackenzie Valley area in the winter season, and that the autumn is cooler than observed in the earlier period. In spring, the northern part of the region would appear to have become cooler since 1970 while the southern stations show warmer temperatures. Summer statistics have changed very little since Burns' work was completed.

Snow depth observations also suffer from a lack of spatial resolution, but individual station data may be compared for the periods before and after 1970. In the early winter mean snow depths have decreased at some stations, but in most cases it is not possible to detect significant changes. In February and March, however, there would appear to be a general decrease in snow depth at most stations.

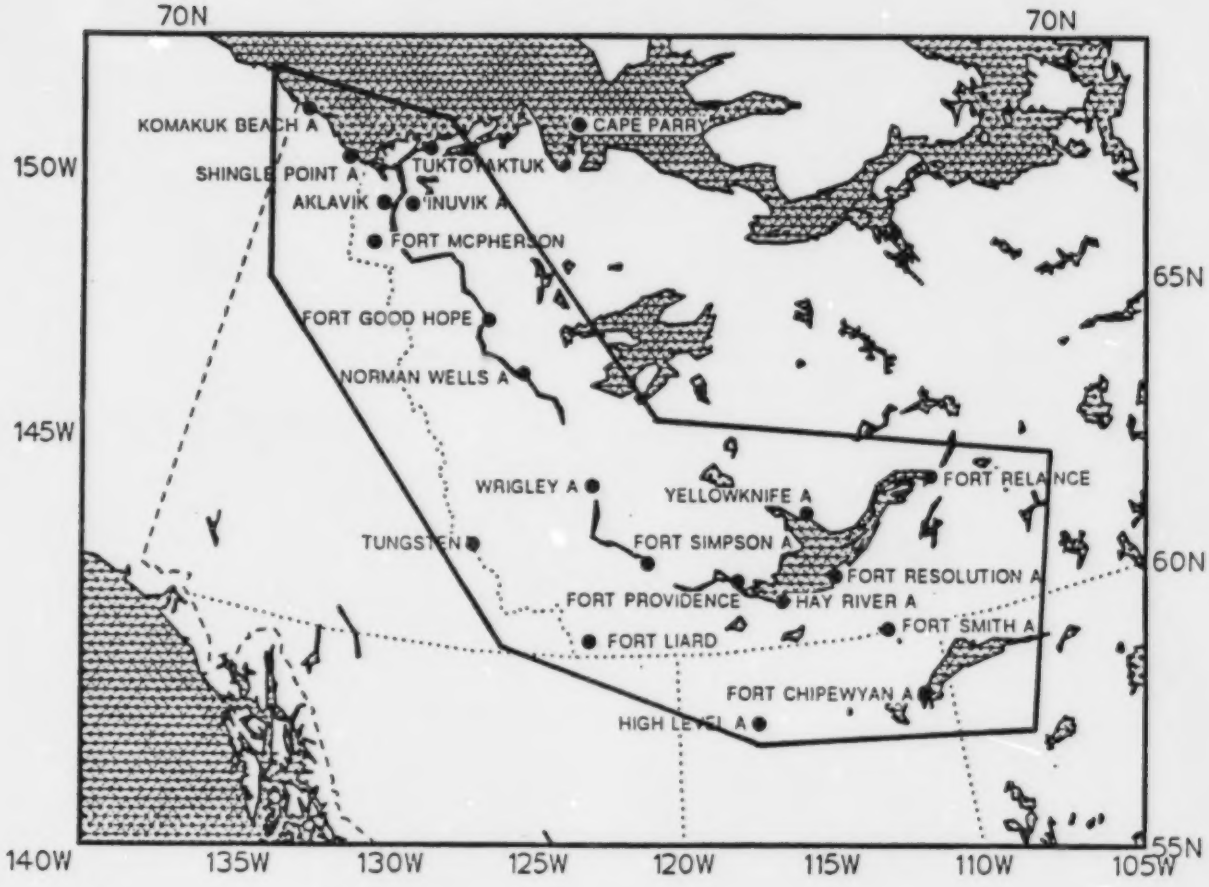
The analysis of upper air data in Arctic regions must take into consideration the fact that in summer the days are very long and in winter they are very short. Twice daily balloon ascents, which for southerly stations may be expected to portray both day-time and night-time conditions, do not necessarily do so in the far north.

Our examination of upper air data in the Mackenzie Valley shows that the nocturnal inversion persists throughout the day in the winter, and that this feature lasts for a longer period as one moves further north. The inversion rate at 12Z, which occurs near sunset or at night for most times of the year in the Mackenzie Valley, is highest in winter - as might be expected - but reaches a minimum in October and not in the summer as would be anticipated by heat flux considerations alone.

This study is the first to investigate temperature gradients in the Mackenzie Valley for a data base of some length. Estimated temperature gradients for the first 100 m show that the average monthly nocturnal inversion usually lies between 10 and 30 degrees per kilometre, while

the surface to 85 KPa average is generally less than 10 degrees. Highest values are observed in winter, and lowest values occur in autumn.

Several important questions remain unanswered at this point in our study. Because of the small number of stations in the region with time-series long enough to be reliable, Burns was able to draw his temperature maps for the region only by making certain assumptions about the relationship between the variance of surface temperature with altitude and mean upper air temperature gradients. The errors implicit in making this assumption have not been ascertained, and this is yet to be done. A second question has to do with the impact of observed changes in temperature and snow depth mean values on soil temperatures and the probability of permafrost in the Mackenzie Valley. Finally, it is necessary to determine if the observed changes in mean monthly temperatures and snow depths before and after 1970 have occurred systematically with time or if the changes are merely random fluctuations resulting from a much higher year-to-year variance. These questions are addressed in the following chapters.



Environment Canada
Atmospheric Environment

Figure 2.1: Study Area

TEMPERATURE DATA

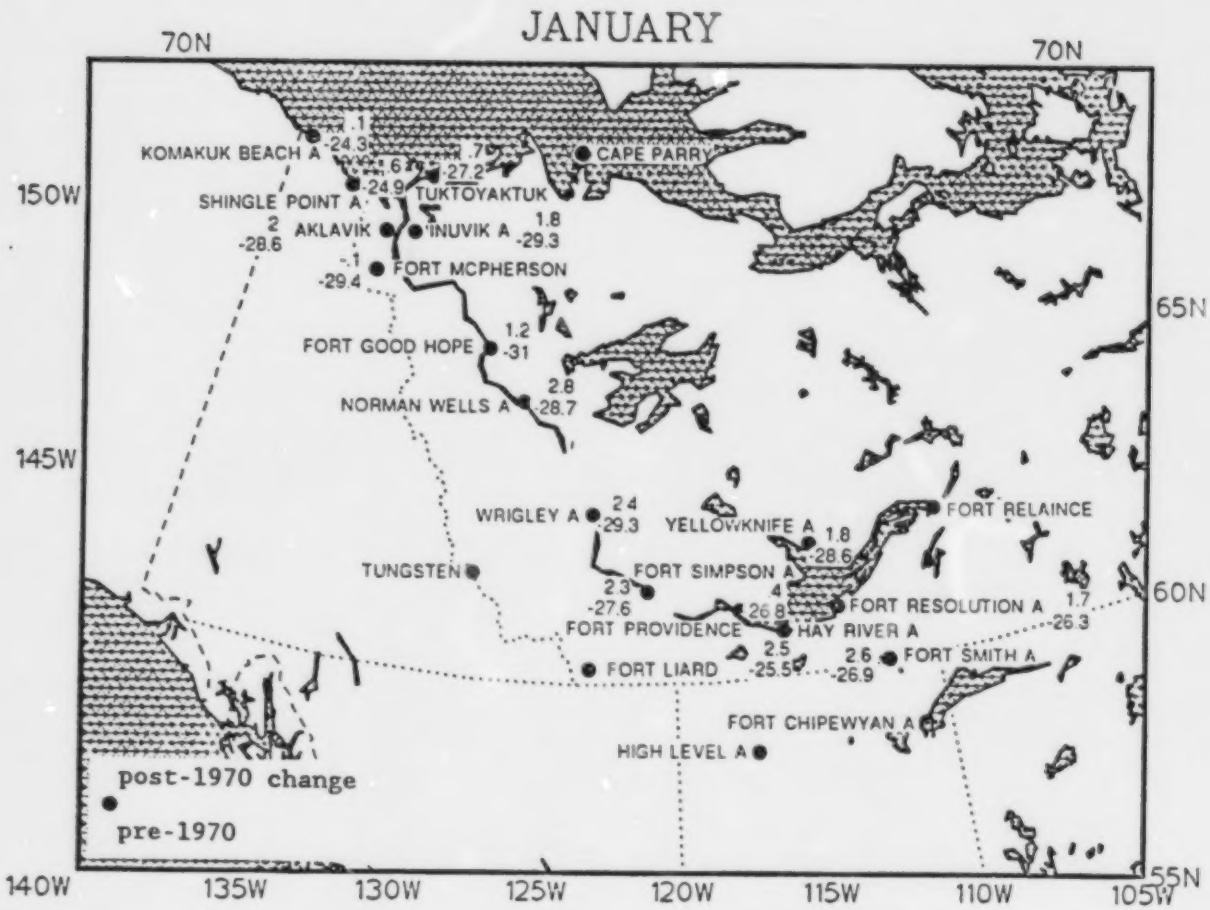


Figure 2.2: January Mean Daily Temperature
1941-70 and post-70.

TEMPERATURE DATA

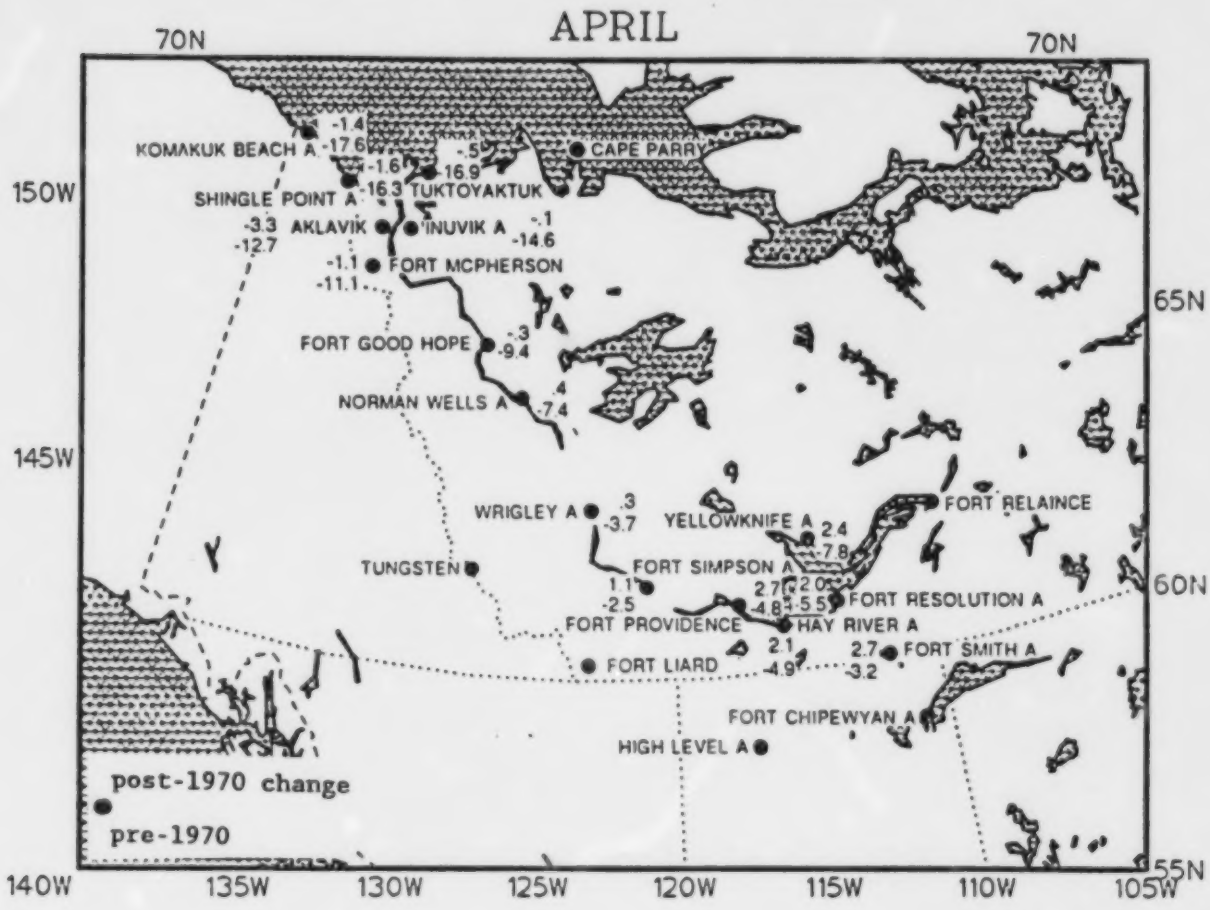


Figure 2.3: April Mean Daily Temperature
1941-70 and post-70.

TEMPERATURE DATA

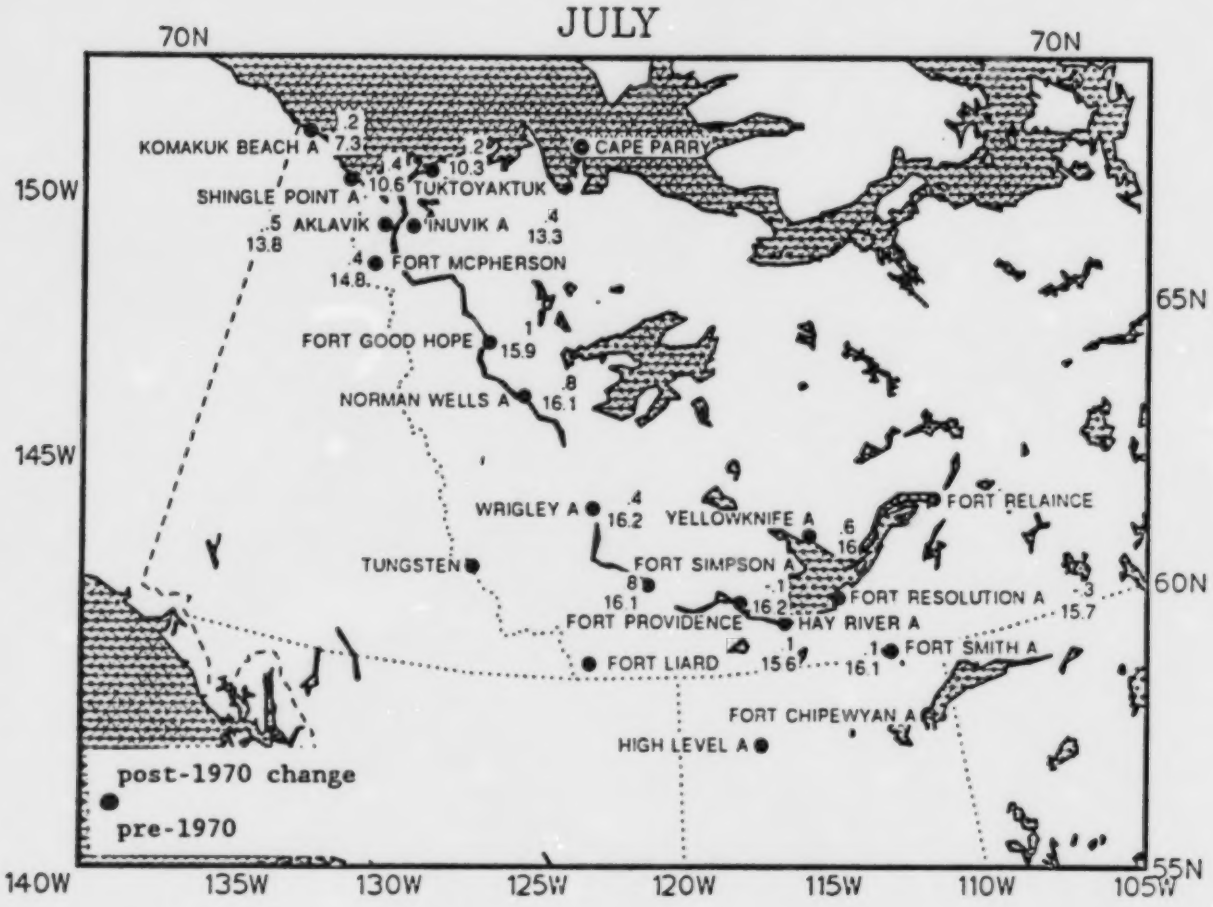


Figure 2.4: July Mean Daily Temperature
1941-70 and post-70.

TEMPERATURE DATA

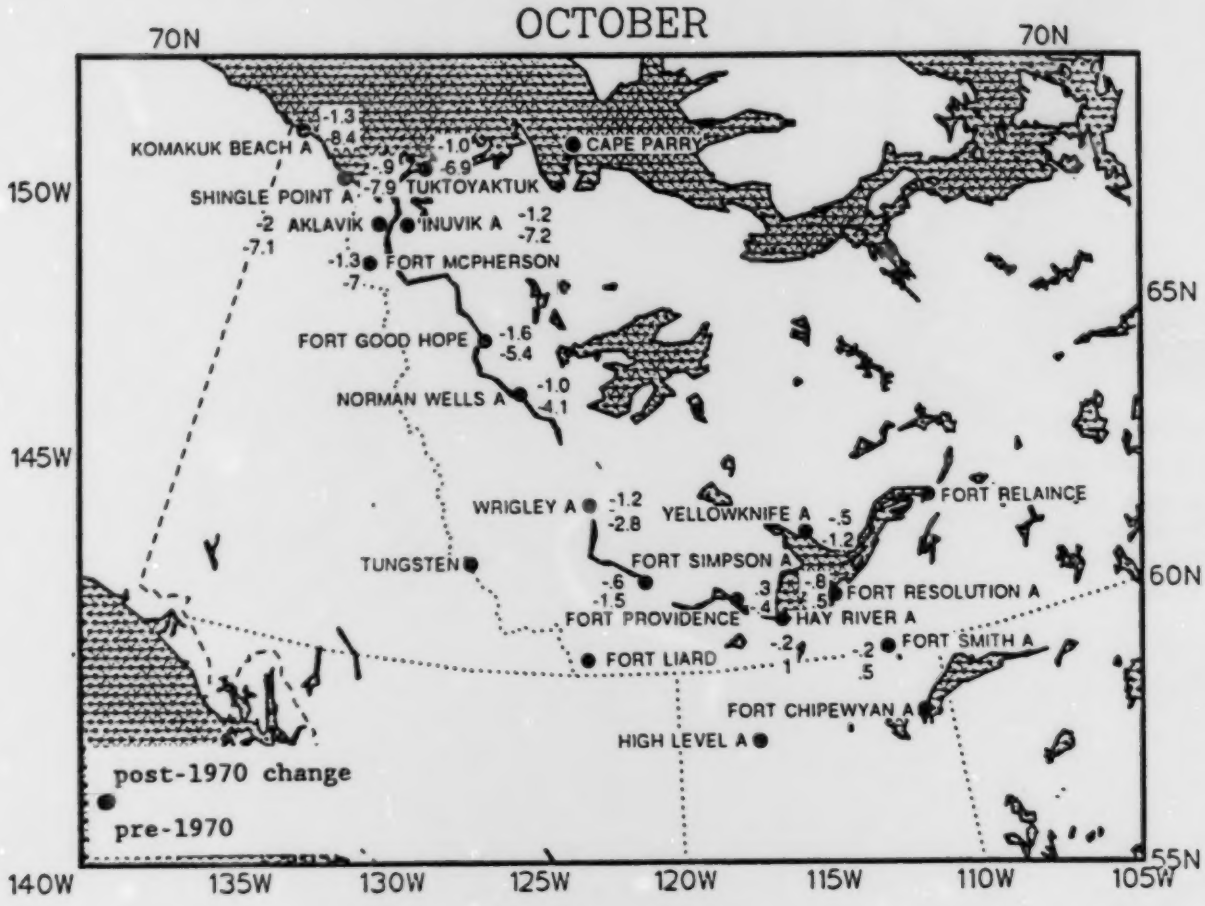
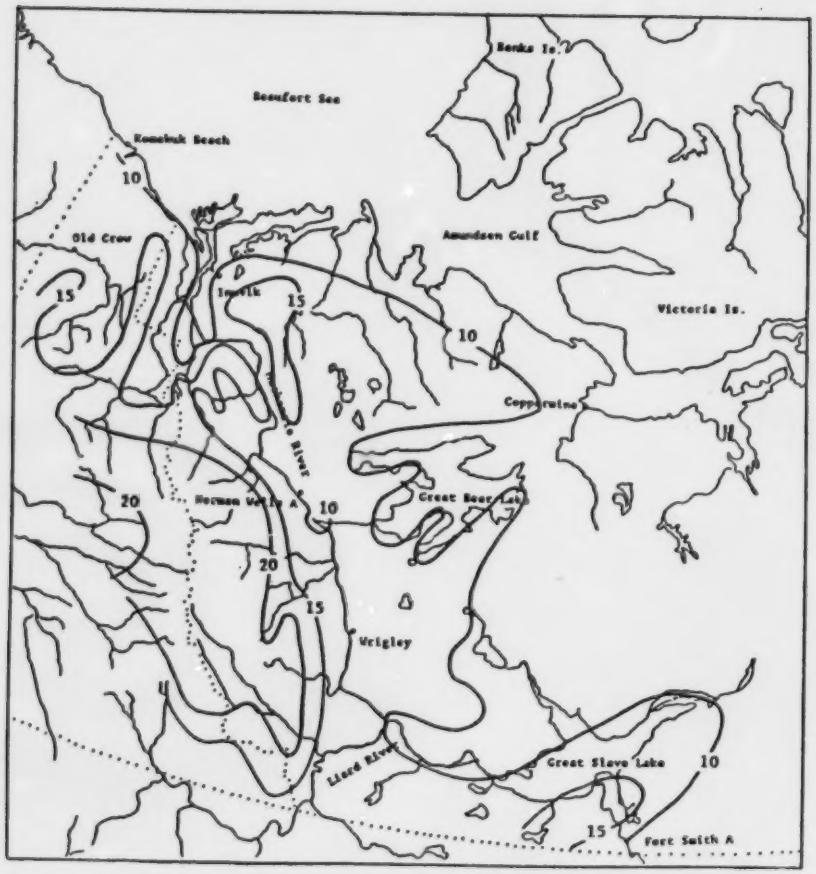
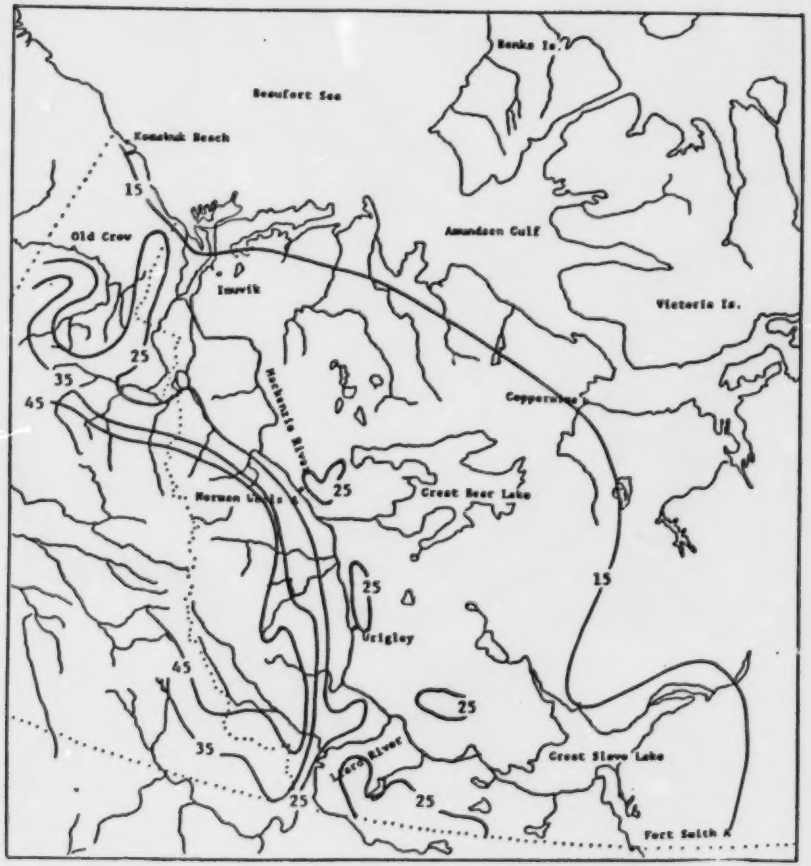


Figure 2.5: October Mean Daily Temperature
1941-70 and post-70.



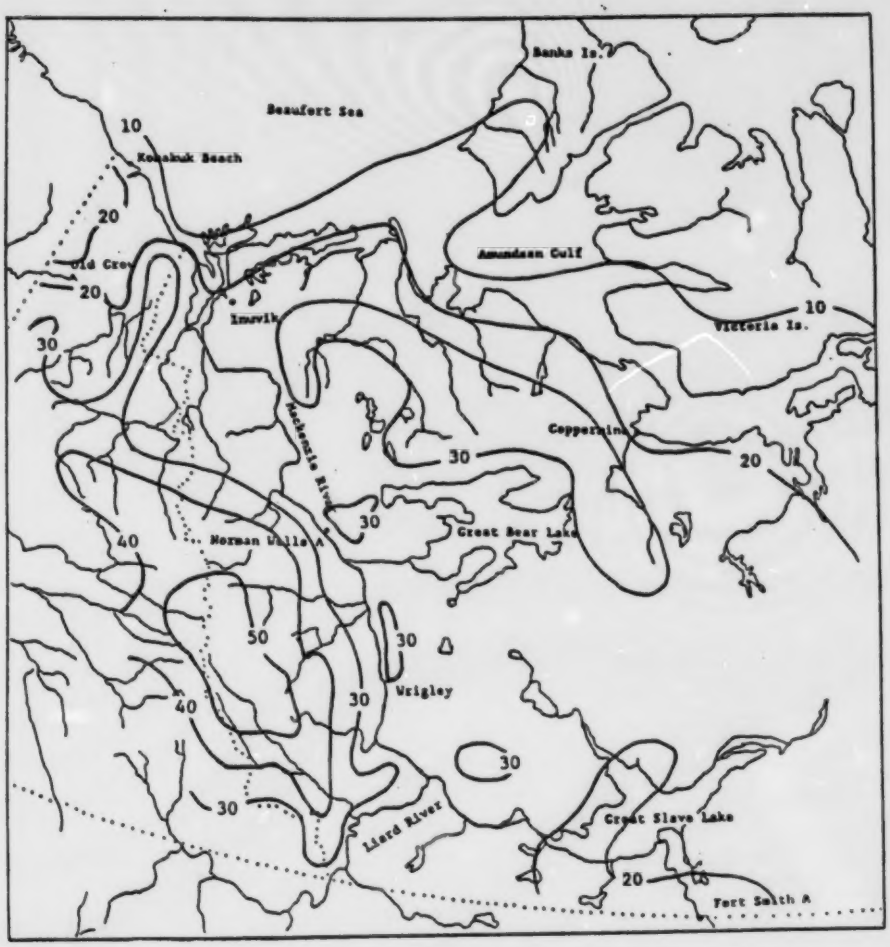
Mean Snow Depth on November 30 (Inches)
Based on the Period 1941-70.

Figure 2.6a:



Mean Snow Depth on January 31 (Inches)
Based on the Period 1941-70.

Figure 2.7a:



Mean Snow Depth on March 31 (Inches)
Based on the Period 1941-70.

Figure 2.8a:

SNOW DATA

November

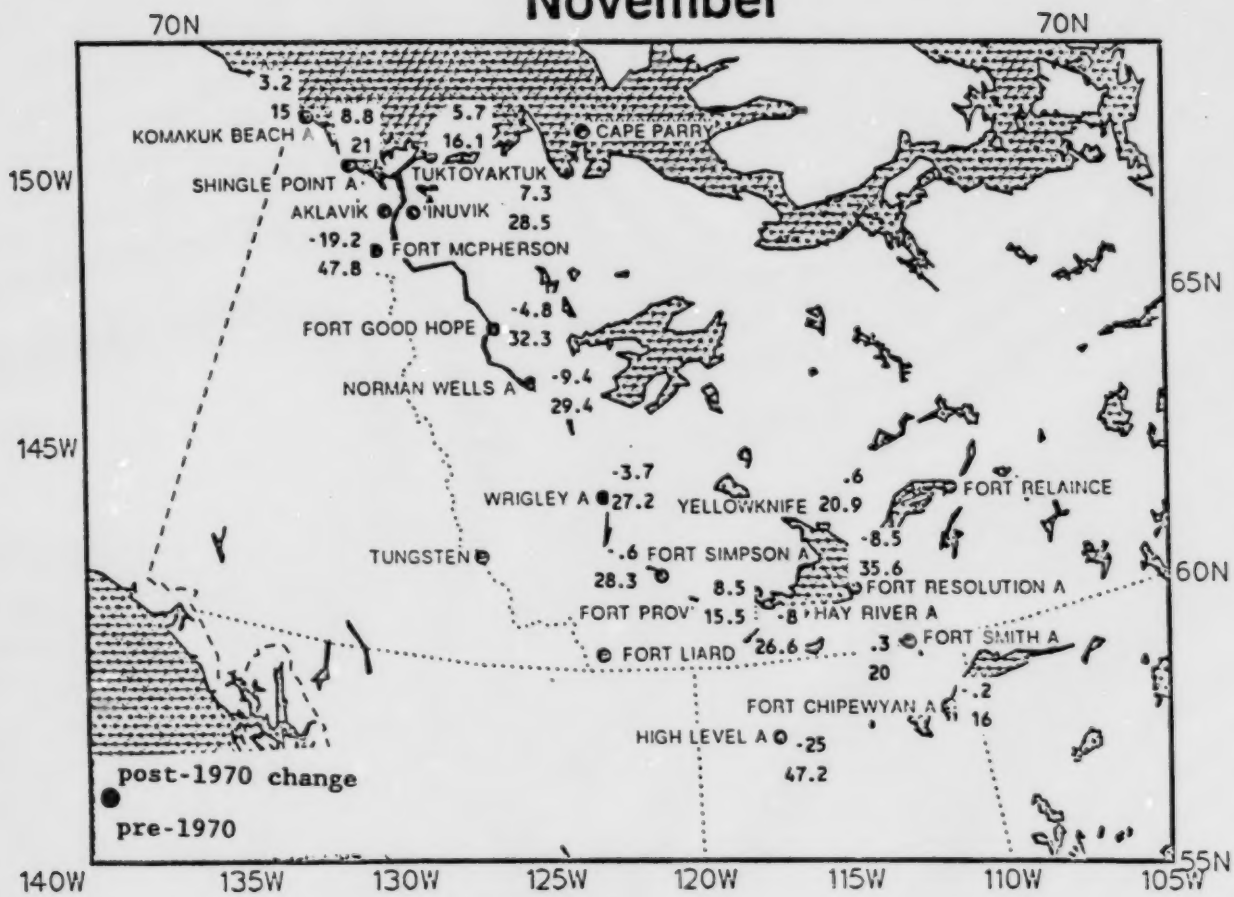


Figure 2.6b: Mean Snow Depth on November 30 (cm)
Pre- 1970 and change.

SNOW DATA

January

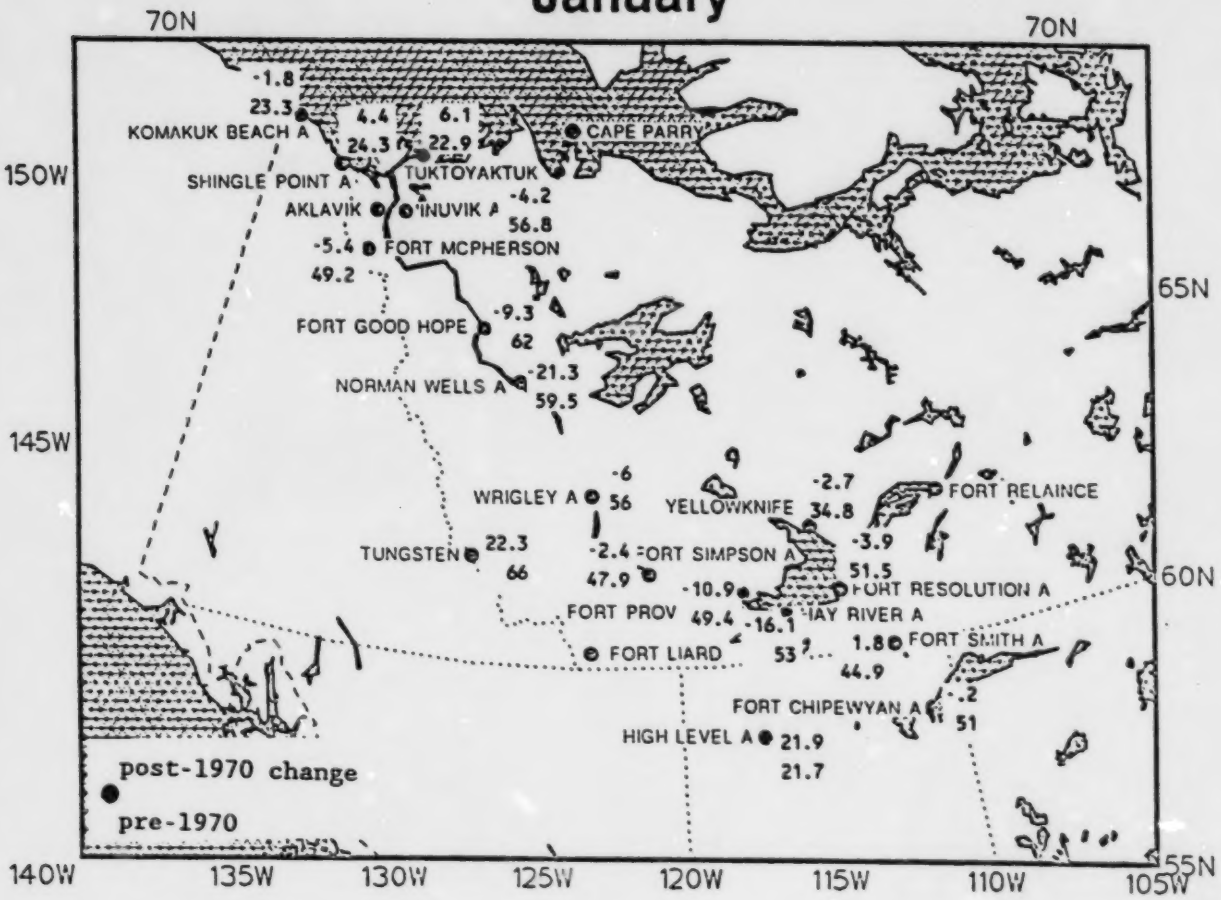


Figure 2.7b: Mean Snow Depth on January 31 (cm)
Pre- 1970 and change.

SNOW DATA

March

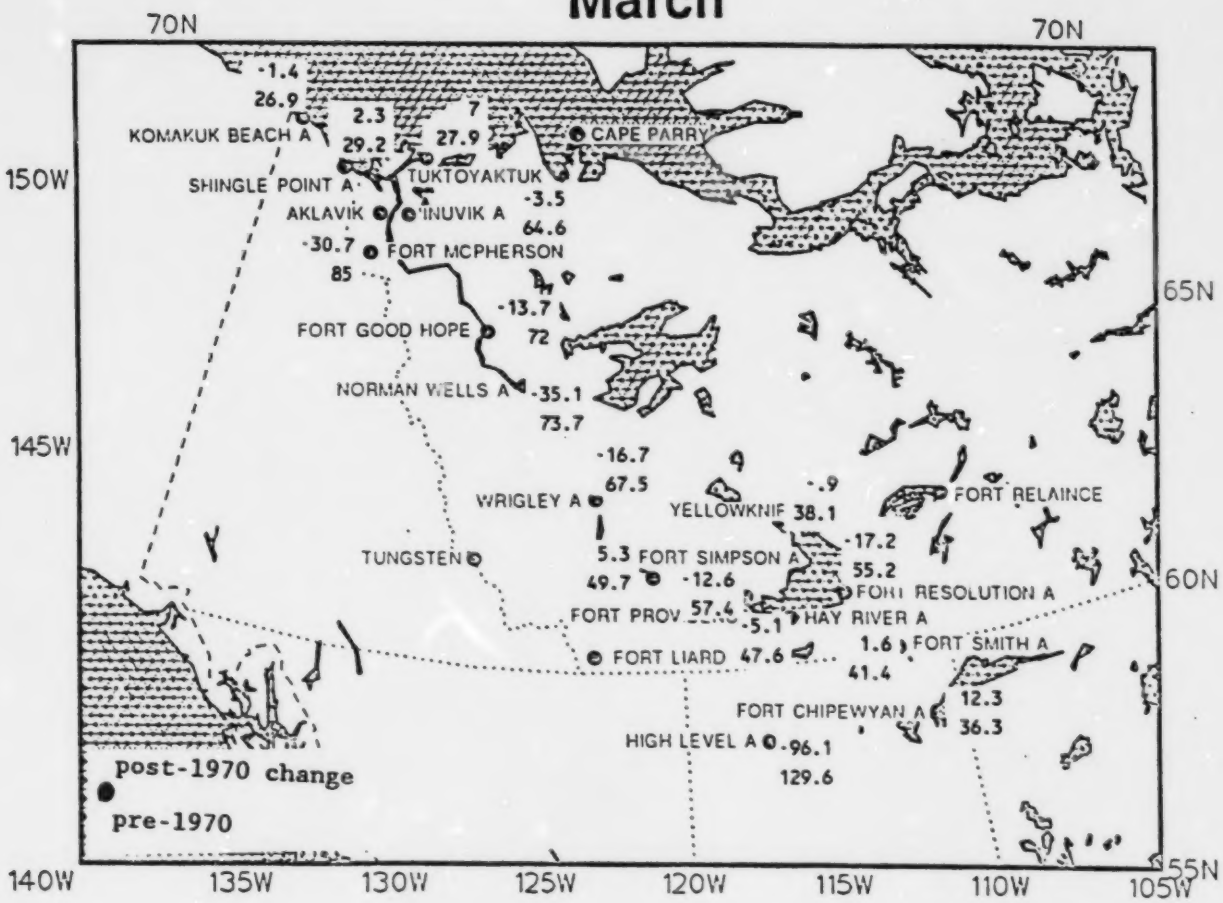
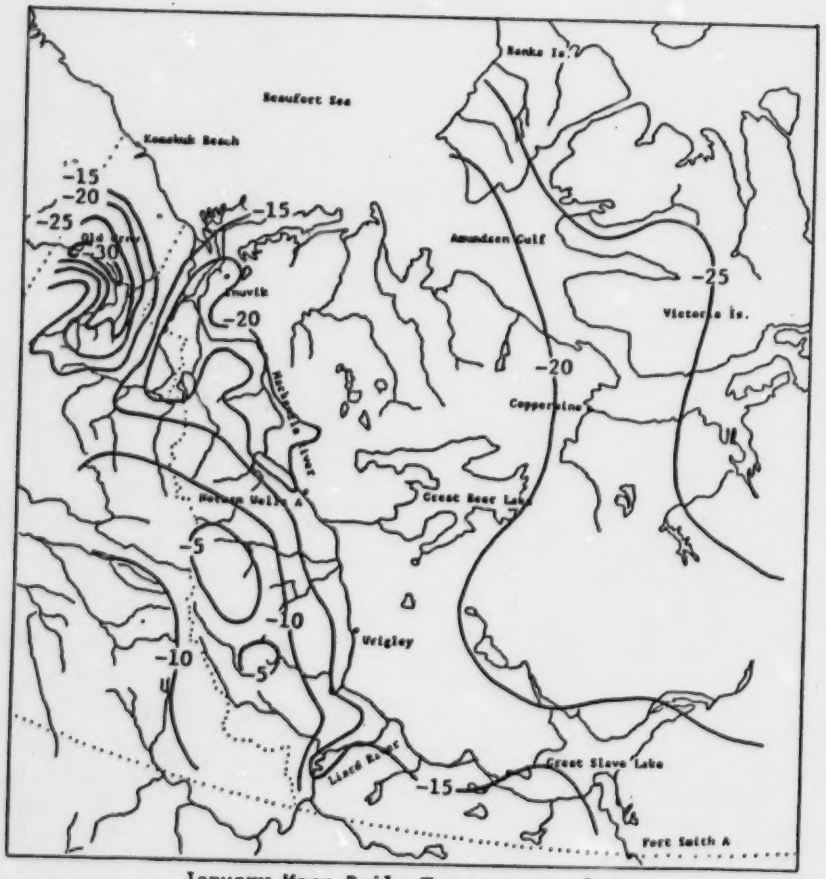
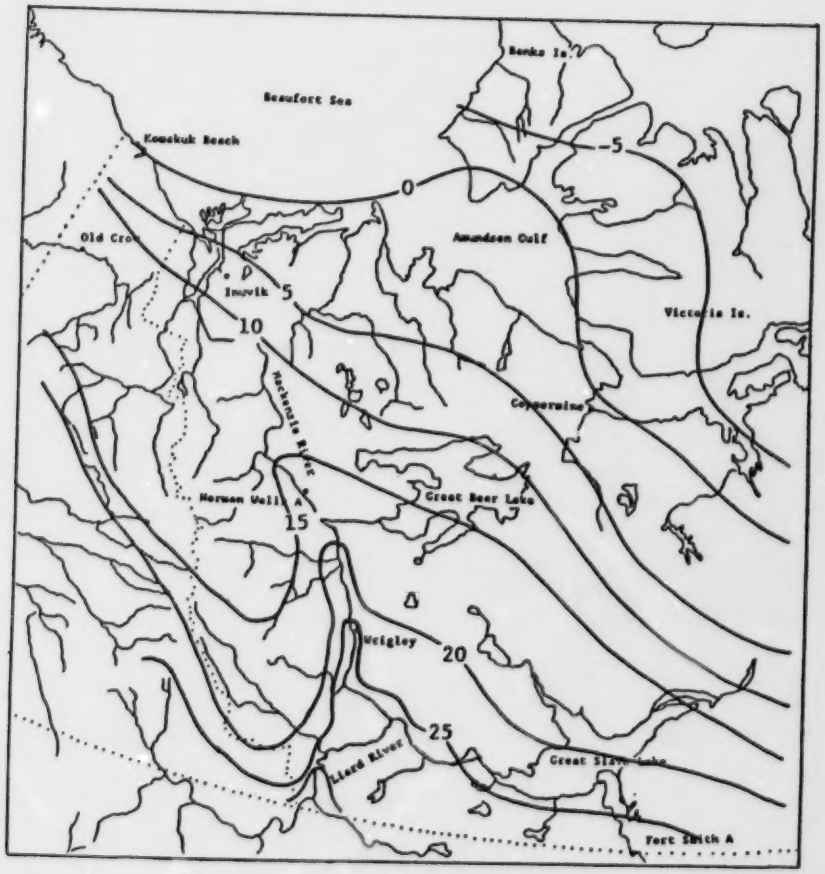


Figure 2.8b: Mean Snow Depth on March 31 (cm)
Pre- 1970 and change.



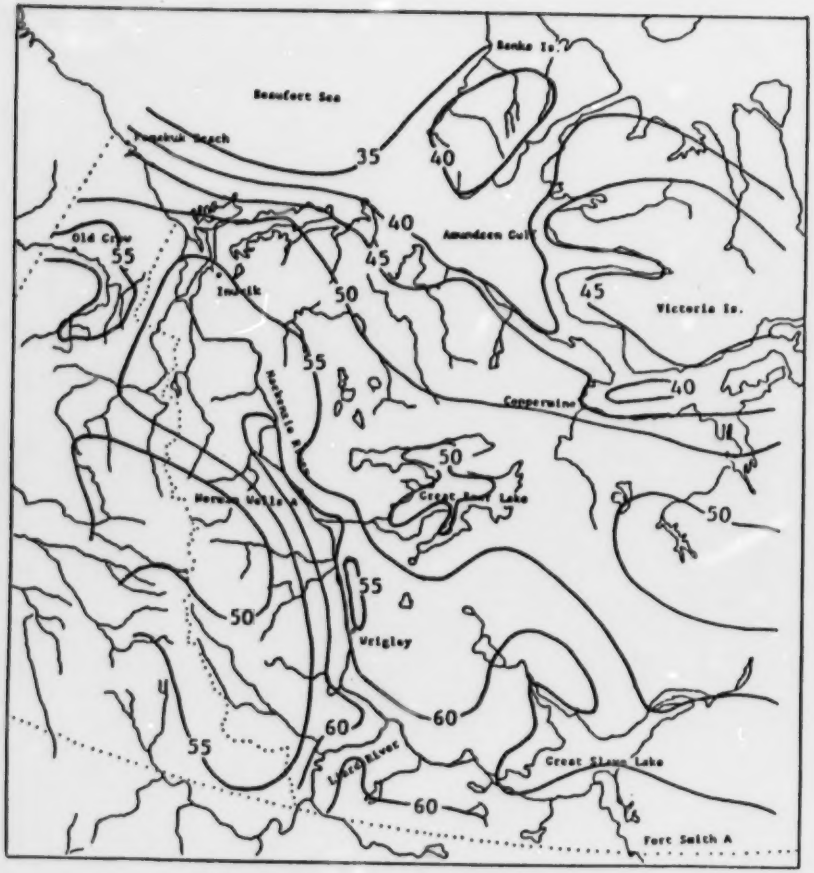
January Mean Daily Temperature (°F)
Based on period 1941-1970

Figure 2.9:



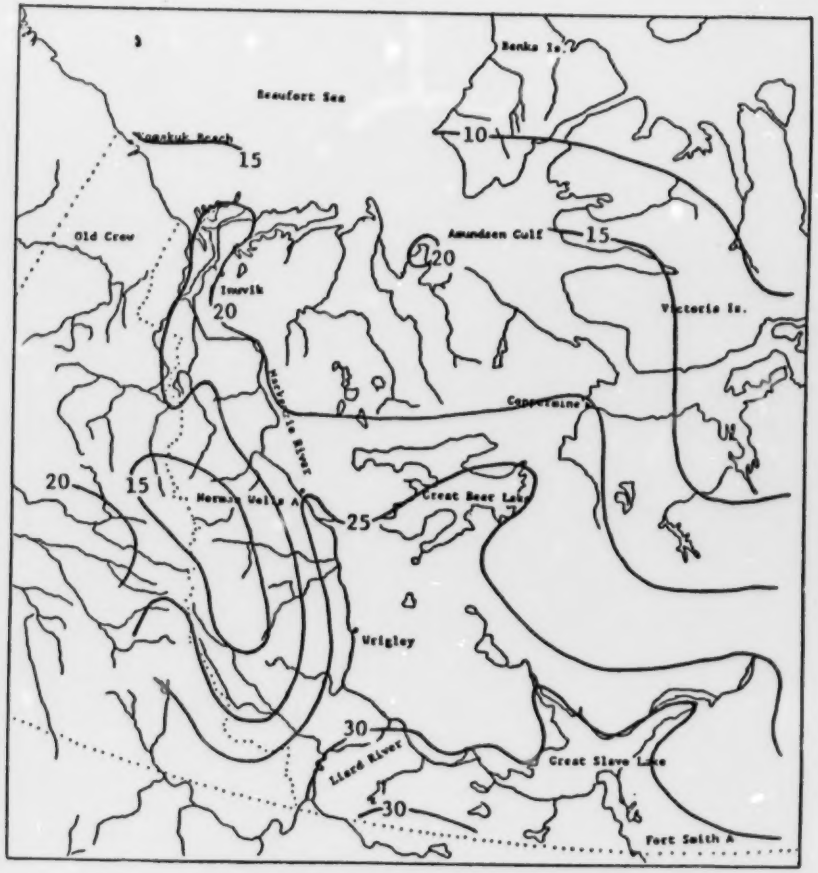
April Mean Daily Temperature (°F)
Based on period 1941-1970

Figure 2.10:



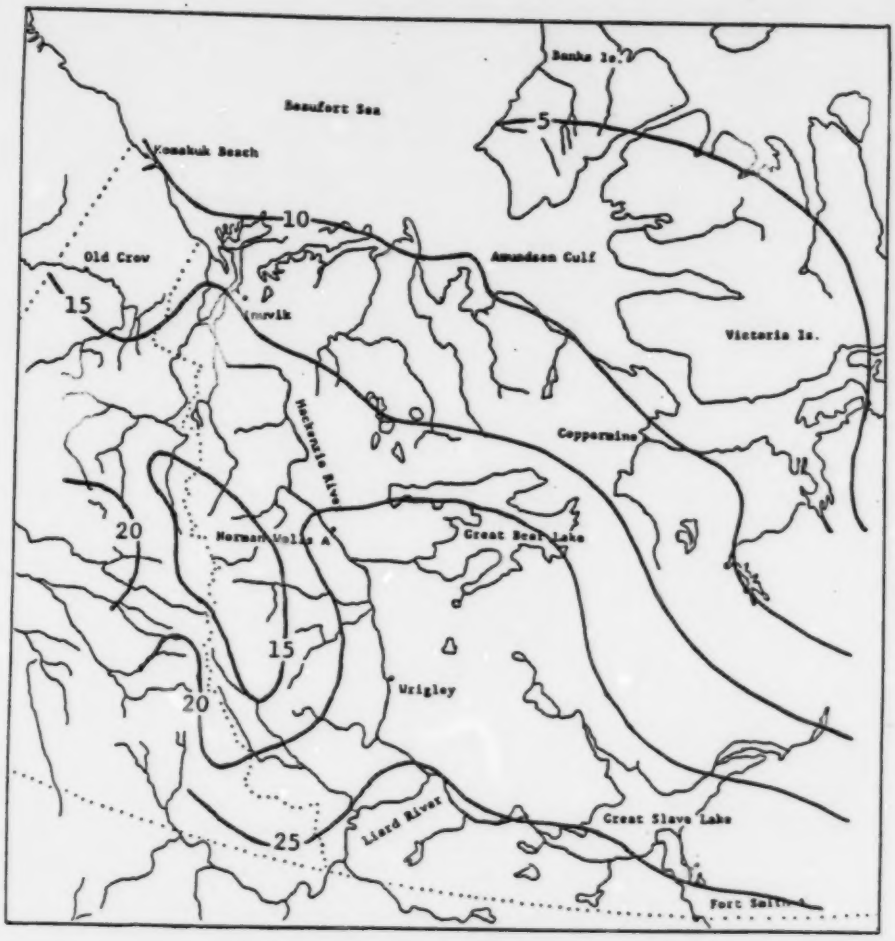
July Mean Daily Temperature (°F)
Based on period 1941-1970

Figure 2.11:



October Mean Daily Temperature (°F)
Based on period 1941-1970

Figure 2.12:



Annual Mean Daily Temperature (°F)
Based on period 1941-1970

Figure 2.13:

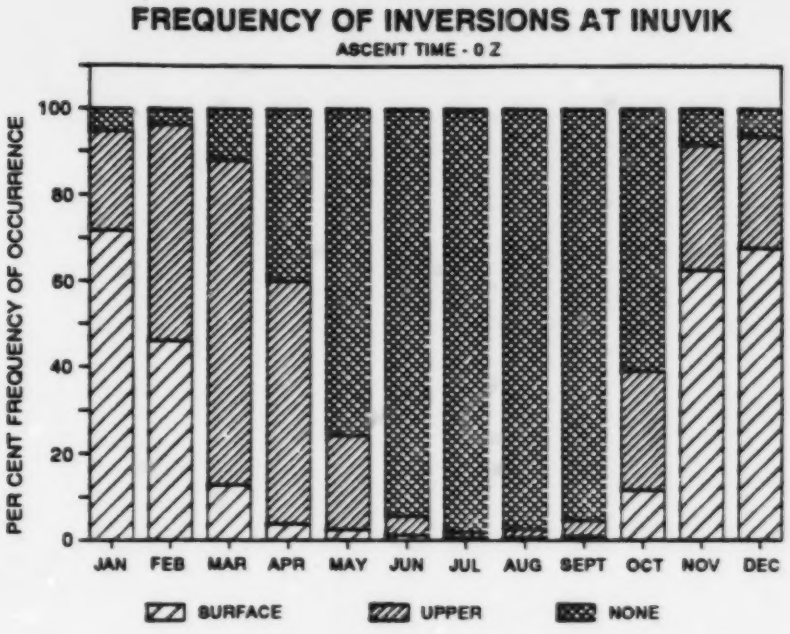


Figure 2.14a: Mean monthly frequency of surface and upper level inversions at Inuvik, N.W.T. for 0 Z soundings.

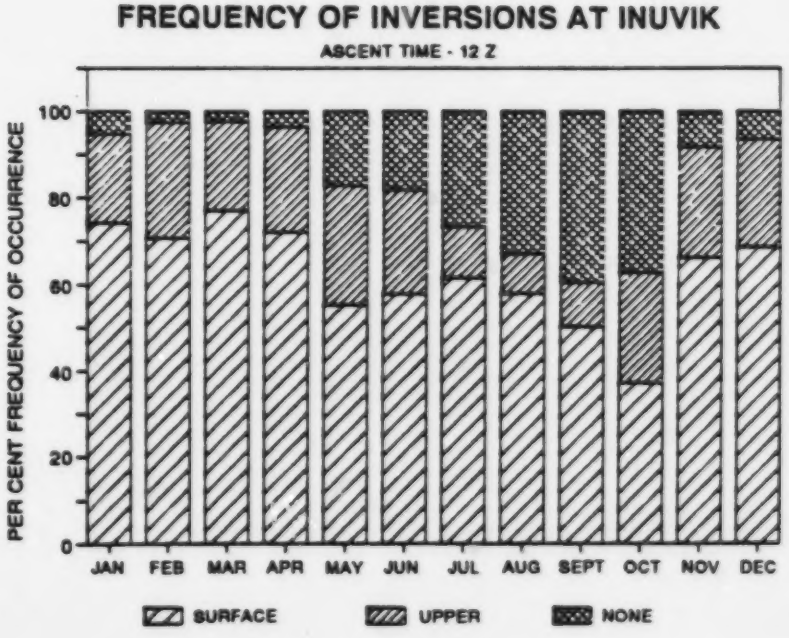


Figure 2.14b: Mean monthly frequency of surface and upper level inversions at Inuvik, N.W.T. for 12 Z soundings.

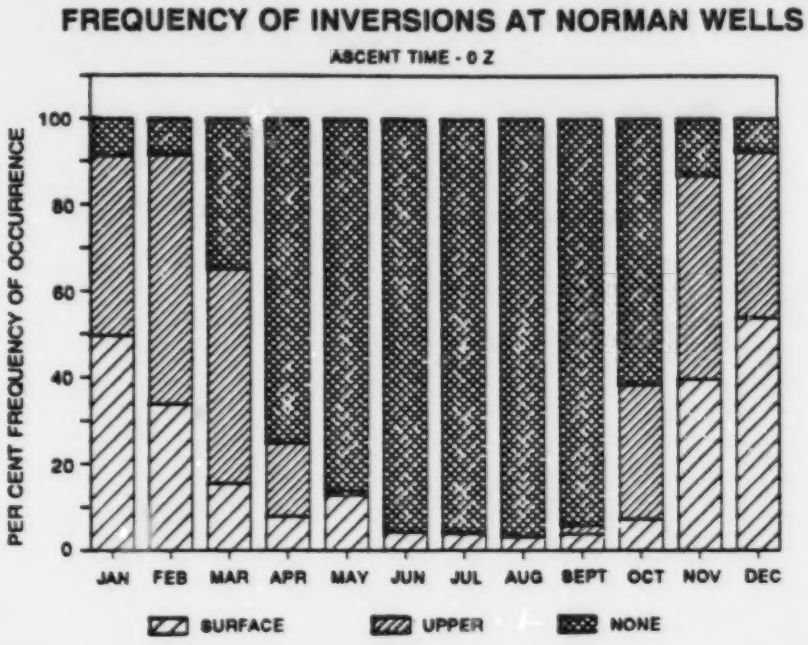


Figure 2.15a: Mean monthly frequency of surface and upper level inversions at Norman Wells, N.W.T. for 0 Z soundings.

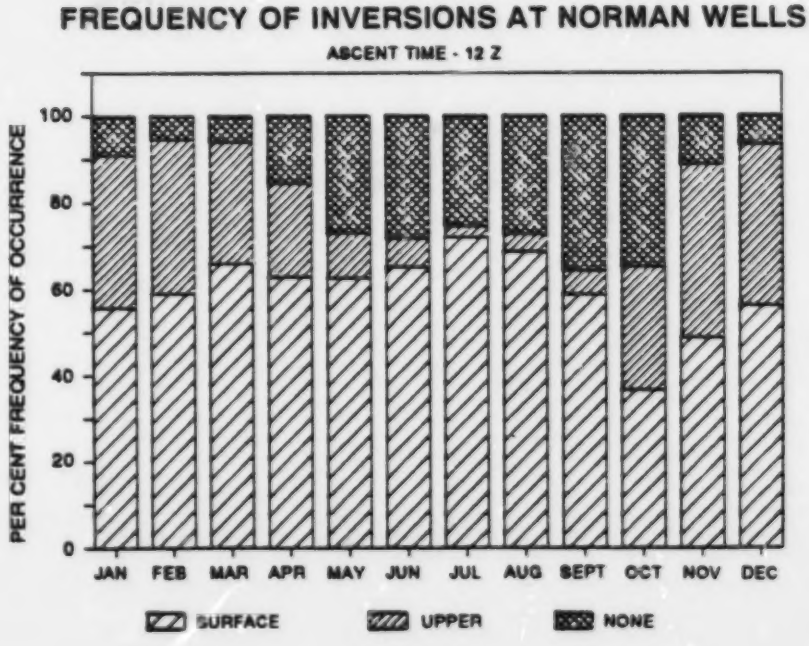


Figure 2.15b: Mean monthly frequency of surface and upper level inversions at Norman Wells, N.W.T. for 12 Z soundings.

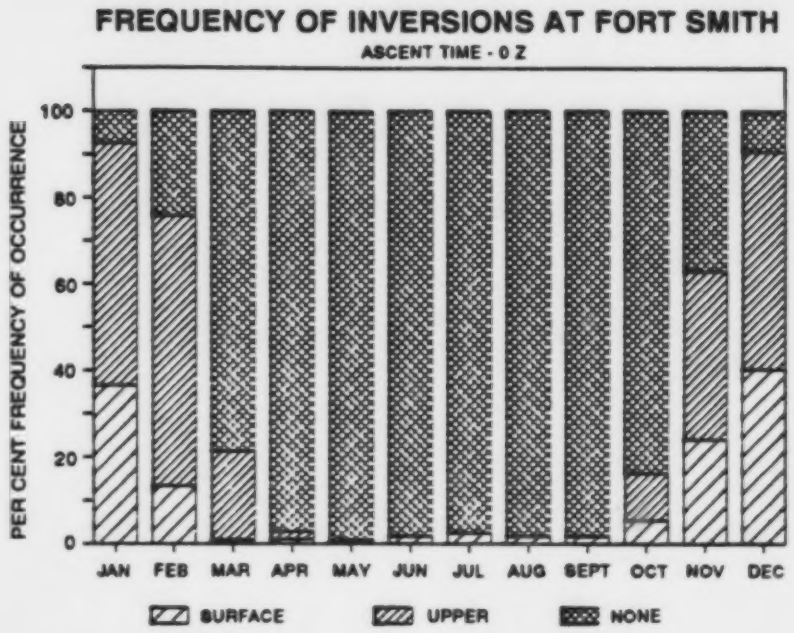


Figure 2.16a: Mean monthly frequency of surface and upper level inversions at Fort Smith, N.W.T. for 0 Z soundings.

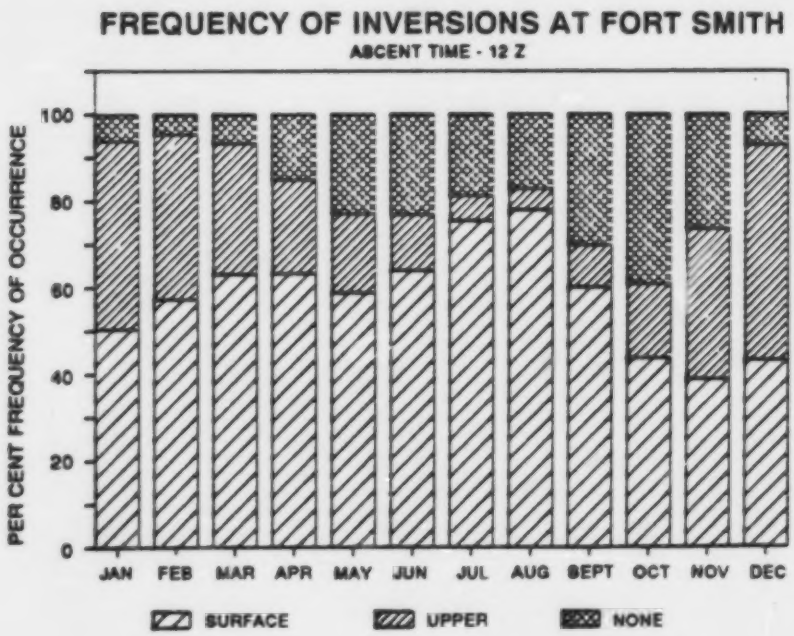


Figure 2.16b: Mean monthly frequency of surface and upper level inversions at Fort Smith, N.W.T. for 12 Z soundings.

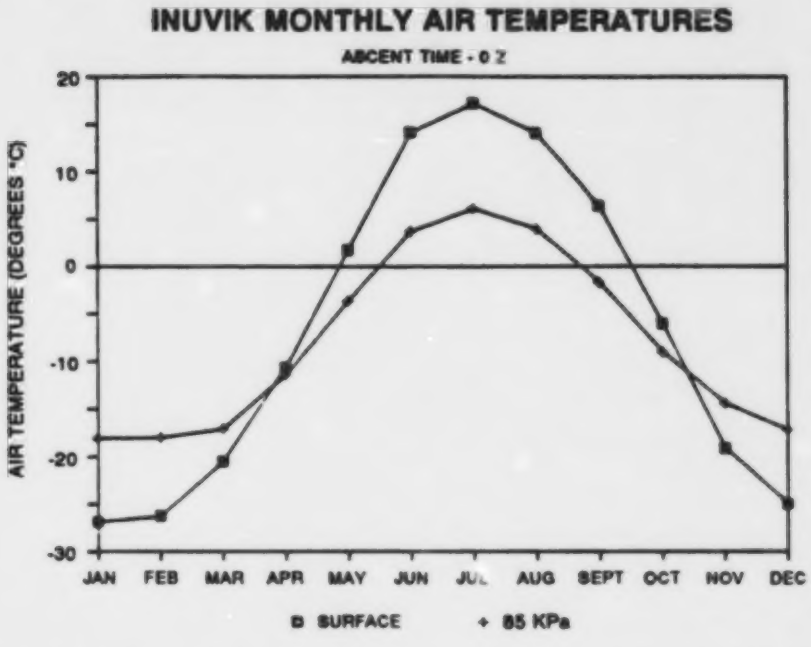


Figure 2.17a: Mean monthly air temperatures at the surface and at 85 KPa at Inuvik, N.W.T. for 0 Z soundings.

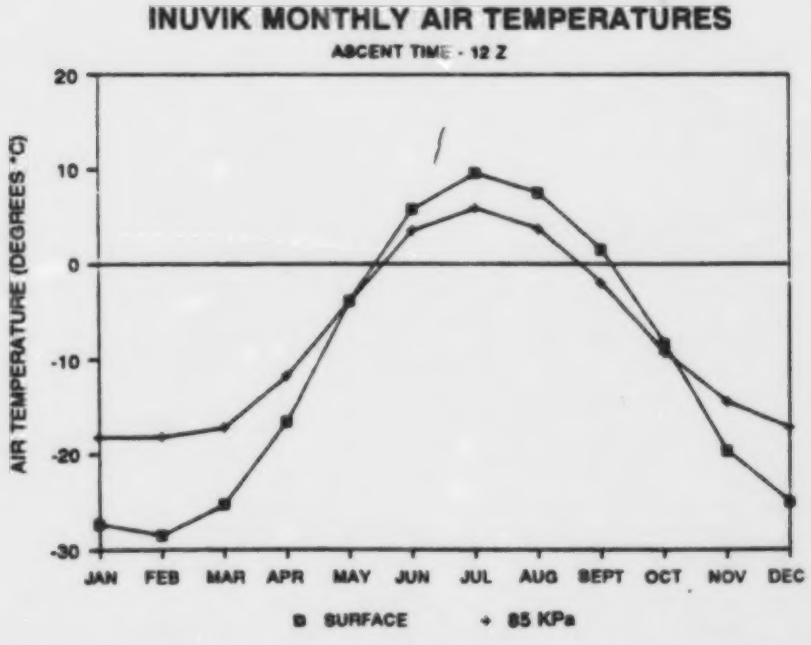


Figure 2.17b: Mean monthly air temperatures at the surface and at 85 KPa at Inuvik, N.W.T. for 12 Z soundings.

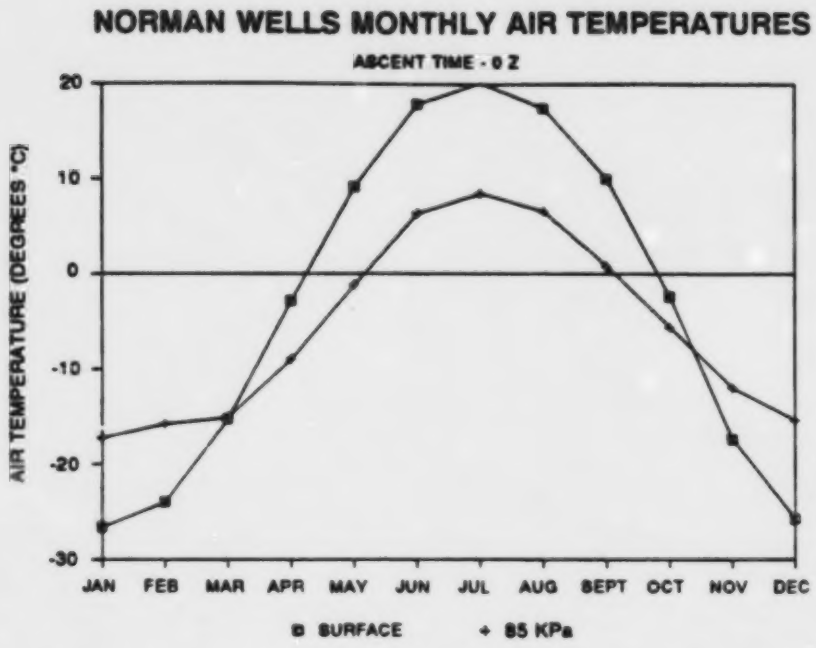


Figure 2.18a: Mean monthly air temperatures at the surface and at 85 KPa at Norman Wells, N.W.T. for 0 Z soundings.

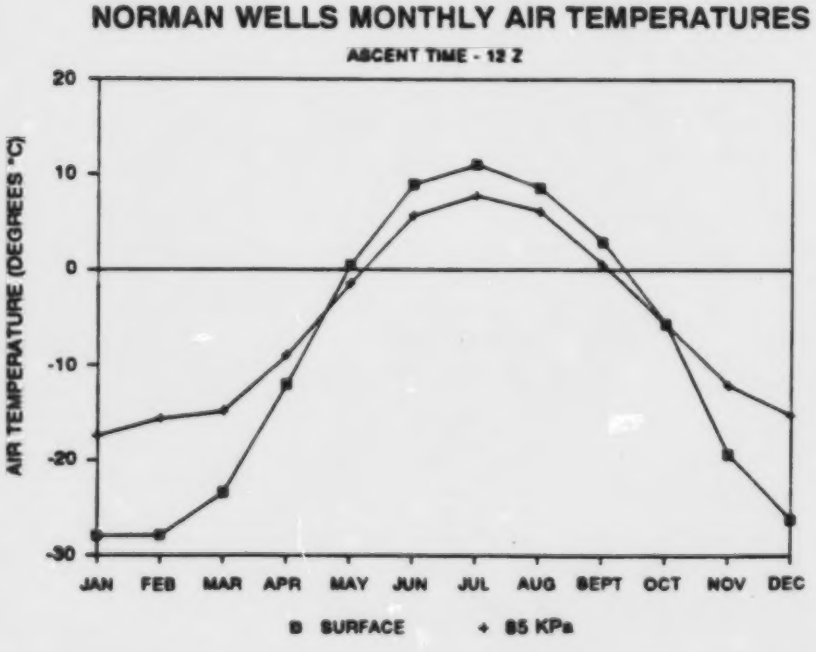


Figure 2.18b: Mean monthly air temperatures at the surface and at 85 KPa at Norman Wells, N.W.T. for 12 Z soundings.

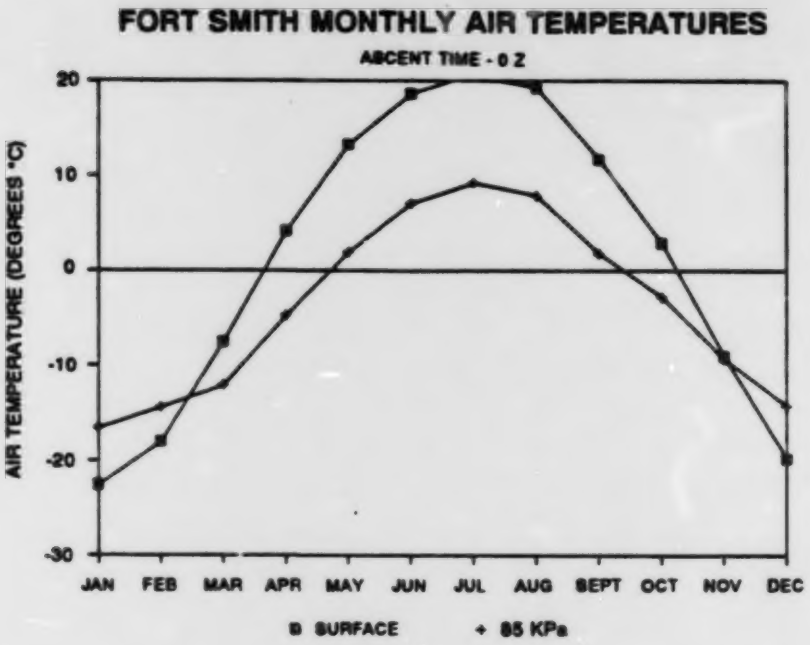


Figure 2.19a: Mean monthly air temperatures at the surface and at 85 KPa at Fort Smith, N.W.T. for 0 Z soundings.

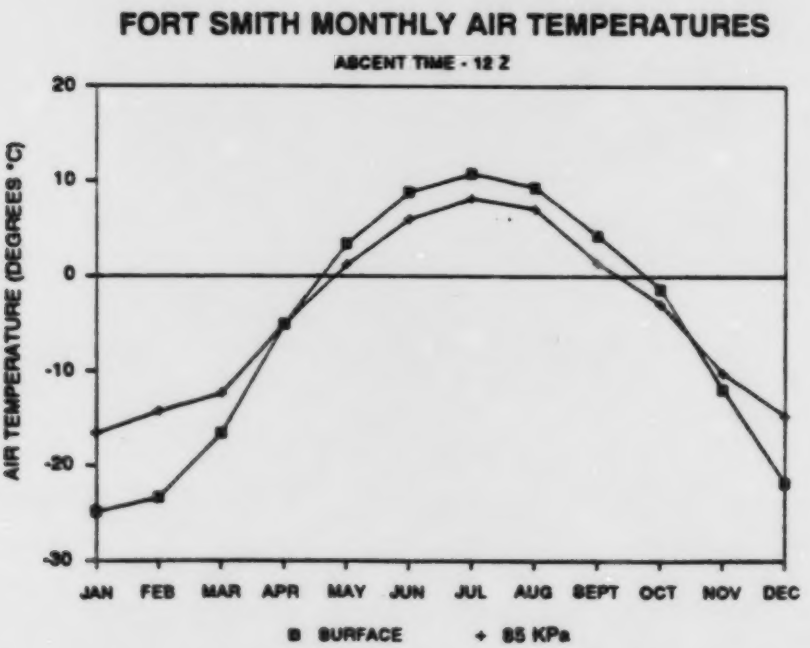


Figure 2.19b: Mean monthly air temperatures at the surface and at 85 KPa at Fort Smith, N.W.T. for 12 Z soundings.

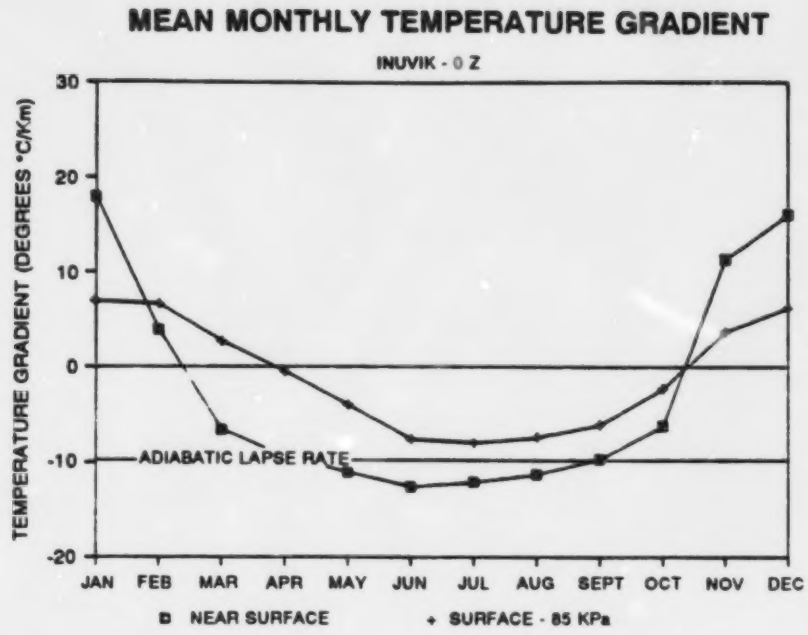


Figure 2.20a: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Inuvik, N.W.T. for 0 Z soundings.

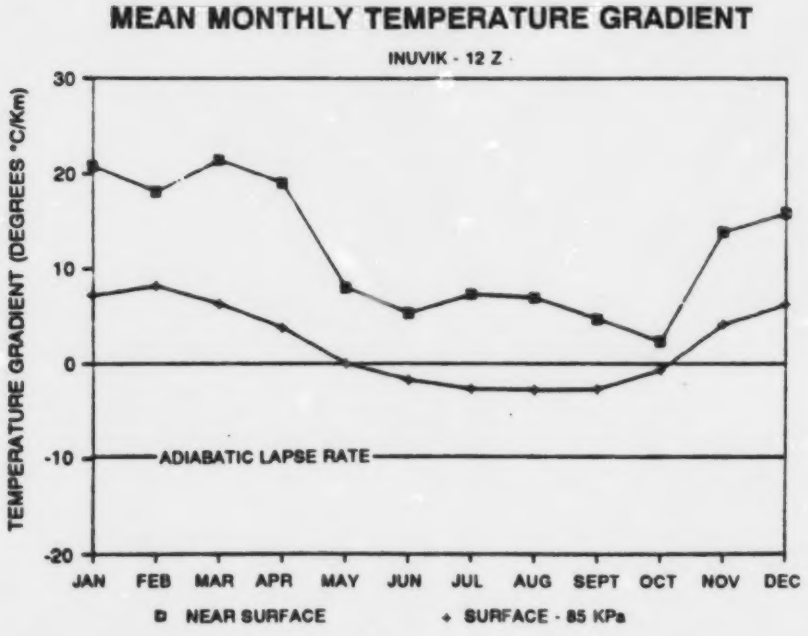


Figure 2.20b: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Inuvik, N.W.T. for 12 Z soundings.

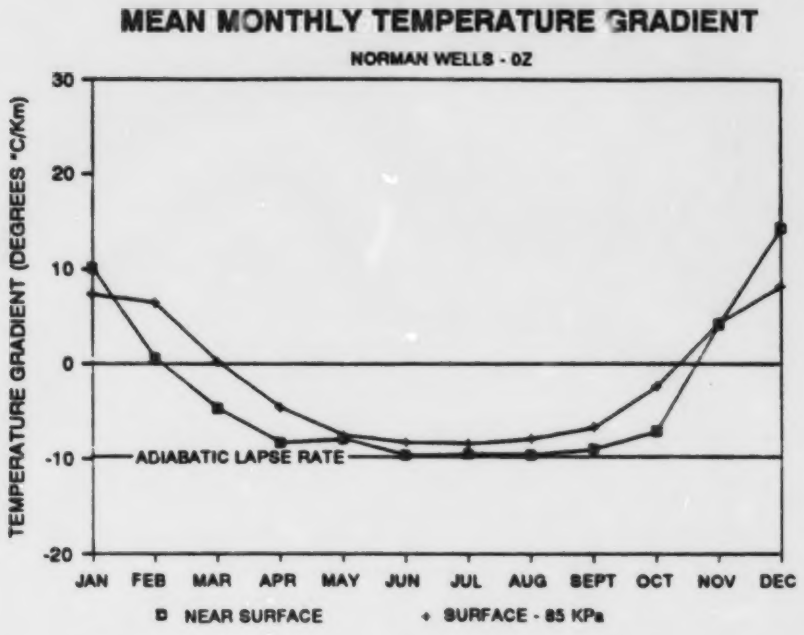


Figure 2.21a: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Norman Wells, N.W.T. for 0 Z soundings.

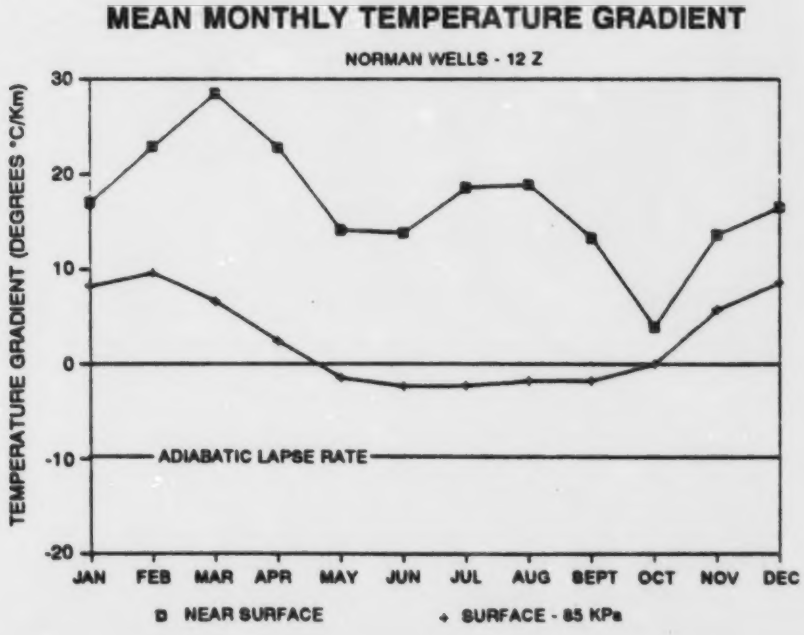


Figure 2.21b: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Norman Wells, N.W.T. for 12 Z soundings.

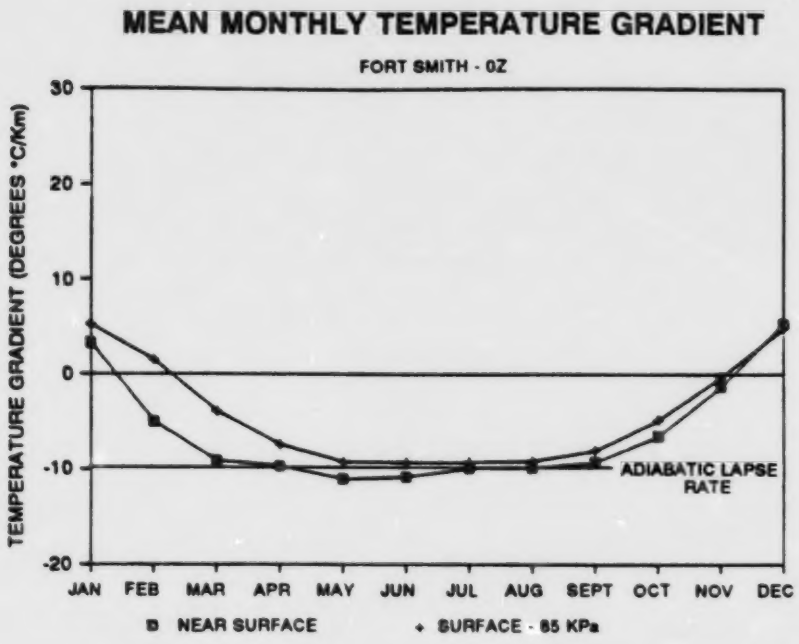


Figure 2.22a: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Fort Smith, N.W.T. for 0 Z soundings.

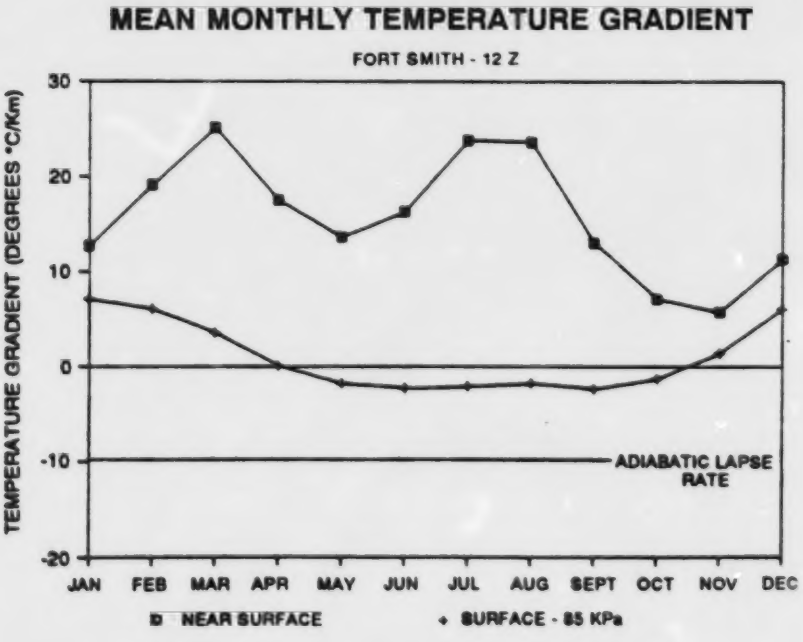


Figure 2.22b: Mean monthly air temperature gradients near the surface and in the surface to 85 KPa layer at Fort Smith, N.W.T. for 12 Z soundings.

3. A TREND ANALYSIS OF RECENT TEMPERATURE AND SNOW DEPTH FLUCTUATIONS IN THE MACCKENZIE VALLEY

3.1 INTRODUCTION

The results presented in Chapter 2 have shown that mean monthly air temperature and end of month snow depth observations at several observing stations in the Mackenzie Valley have changed since 1970 with warmer temperatures and reduced snow depths generally being observed. In this chapter we examine the significance of these changes. It is certainly possible that the changes are merely the result of large scale random variations that show no definite time trends, and should this be the case, we must anticipate further random fluctuations in the future. On the other hand, the warmer temperatures and decreased snow depths may have occurred in such a way that definite trends may be detected within the usual year-to-year variability.

Time trends may only be examined at stations with a sufficiently long time series of observations. An analysis of all available stations in the AES archive shows that of all the stations in the Mackenzie Valley only 16 are capable of supporting a trend analysis. In the north these stations include the Arctic coastal stations of Tuktoyaktuk, Shingle Point A and Komakuk Beach, and the Mackenzie Delta station of Inuvik A; the stations of Fort Good Hope, Norman Wells A and Wrigley A in the mid-Valley area as well as Tungsten in the mountains near the Yukon border; in the south, we may examine Fort Simpson A, Fort Liard, Hay River A, Fort Resolution A and Yellowknife A in the upper-Valley and Great Slave Lake area, and Fort Smith A, Fort Chipewyan A and High Level A which lie to the south of Great Slave Lake and into Alberta.

For each of these stations we will examine the monthly mean temperatures and end of month snow depths as these are available. Much of the year-to-year variability may be removed through the construction of 10 year moving averages. Finally a linear regression for the entire period of record and a second regression analysis for post-1970 observations will be calculated. From these analyses, the significance of all trends will quantitatively determined.

3.2 RESULTS FOR SURFACE AIR TEMPERATURE

A summary of regression analyses for all stations is given in Appendix 3. Mean monthly air temperatures and annual air temperatures are examined for the entire period of record and again for the period after 1970. For each time period, the straight line with the best fit to the series of monthly (annual) values is derived; the slope of each line and its intercept for the year 1900 is calculated. Also included in the analysis are the standard error of estimate of the slope and intercept values. Of particular importance to this study is the slope estimate - which identifies either positive or negative trends with time - and the standard error of estimate of the slope - which is a measure

of confidence of the sign of the slope. The analysis also provides the percentage of variance explained by the straight line estimate (the "R Squared" value), and the number of observations in the analysis and the associated degrees of freedom. For snow depth a similar procedure is employed for all months in which there is sufficient snow on the ground to provide a valid analysis.

Confidence levels associated with positive or negative slopes are based on the ratio of the estimated slope and its standard error of estimate. Regression analysis theory assumes that the estimated slope and its error of estimate are respectively the mean and standard deviation of a normal distribution of possible slope estimates that would be generated by a large number of realizations of the input data set. Consequently, the probability that the actual slope is positive (negative) is given by the fraction of this normal distribution function which applies to positive (negative) estimates of the distribution mean. If the slope estimate is exactly zero, for example, the associated normal distribution function would be symmetrical about the origin with half of its area over positive numbers and half over negative numbers. In this case the confidence that the slope was positive would be exactly 50 per cent, and would be equal to the probability that the slope was negative. For non-zero slope estimates, the probability that the slope is the same sign as the estimate will be greater than 50 per cent. If the absolute value of the slope estimate is much greater than its associated standard error of estimate, the normal distribution of slope estimates will be remote from the origin and a high fraction of its area will lie over values that have the same sign as the estimate. This in turn will result in a high confidence level that the actual slope has the same sign as its estimate. Conversely, if the standard error of the slope estimate is much greater than the absolute value of this estimate, then a significant section of the associated normal distribution will lie over numbers whose sign is different from the sign of the slope estimate. However, because the symmetry line of the normal distribution coincides with the slope estimate, the fraction of the normal distribution lying over number of sign opposite to the slope estimate can never be greater than 50 per cent.

A one-tailed t-test is used to determine the confidence level that the sign of the slope estimate is identical with the actual, underlying trend. For a very large number of observations, if the ratio of the absolute value of the slope estimate and its associated standard error of estimate exceeds 1.29, then the confidence level of the sign of the slope exceeds 90 per cent. A 95 (99) per cent confidence level is achieved whenever this ratio exceeds 1.64 (2.32). In this study the limited number of years in the data base will require higher ratios for the same confidence levels to be achieved. For example, the post-1970 period has at most 17 observations or 15 degrees of freedom in the regression analysis. With these data, a confidence level of 95 (99) per cent is achieved whenever the ratio of the absolute value of the slope estimate and its associated standard error of estimate exceeds 1.75 (2.60).

In the following analyses all confidence levels will be categorized into four groups: confidence levels of less than 90 per cent, levels greater than 90 per cent but less than 95 per cent, levels greater than 95 per cent but less than 99 per cent and levels greater than 99 per cent. Confidence levels less than 90 per cent or greater than 99 per cent will be clearly identified as such, while the other two levels may often be identified as confidence levels of 90 per cent or 95 per cent respectively for the sake of brevity.

3.2.1 The Mid-Valley Region

Results for the Mid-Valley region, and in particular, the Norman Wells area are of the greatest importance to this study from the point of view of permafrost stability and the apparent trend to warmer soil temperatures. It is for this reason that we look at these stations first. Norman Wells lies in the centre of this region, which also includes Fort Good Hope in the north, Wrigley A to the south and Tungsten in the mountains to the south-west.

The confidence levels for the four mid-valley stations are given in Table 3.1 and the associated time-series plots for the Norman Wells A station are contained in Figures 3.1 - 3.5 for January, April, July, October and mean annual temperatures respectively.

An examination of January temperatures in Norman Wells since 1944 (Figure 3.1) shows the high year-to-year variance of the mean monthly temperature. This year-to-year variance is removed to a great extent by the calculation of ten year moving averages which show a slight warming in the early part of the record followed by a pronounced cooling during most of the sixties and a similarly pronounced warming since 1970. Results from the regression analysis over the entire period of record indicate a mean warming trend of 0.076 °C per year since 1944. This value, combined with a standard error of estimate of 0.058°C per year represents a confidence level of over 90 per cent that a warming has in fact occurred and is not a result of random variance in the data. An analysis of post-1970 data reveals a warming trend of almost 0.4 °C over this period. This value, combined with a standard error of estimate of 0.26°C per annum is equivalent to a confidence level of more than 90 per cent that the trend for this period is positive. An examination of Table 3.1 for other winter months shows that for the post-1970 period, December temperatures are also up with a confidence level of more than 95 per cent. For all other winter months during the post-70 period the level of significance is less than 90 per cent. For the entire period of record, temperatures are up in January and down in November, each with a confidence level of 90 per cent. For the other winter months the level of significance is less than 90 per cent.

Figure 3.2 shows the temperature trends for the month of April. Year to year variability is high, and oscillations with a period of a few years continue to be present in the 10 year moving average statistic. Over the entire period of record the trend indicates warmer temperatures, but the trend is sufficiently small compared with annual

variability that there exists a 25 per cent chance that cooling has actually occurred. For the post-1970 period, the trend is actually negative, but the signal is so slight that there is an almost equal probability that it is positive. Similar conclusions may be drawn for the month of May.

Year-to-year variability in summer is much smaller than any other season as is evident in Figure 3.3. An analysis of July temperatures for the entire period of record indicates a warming trend with a confidence level of 95 per cent, while a near-zero trend is estimated for the post-1970 period. A similarly clear warming trend for the entire period of record is noted for the month of June, but for all other cases, the May-August period shows no clear trend.

In the autumn months of September, October and November all trends have confidence levels greater than 90 per cent, with warming indicated in September and cooling in the other two months. The October plot (Figure 3.4) shows that the cooling is accomplished through a high year-to-year variability, and an oscillatory ten year moving average. For the post-70 period, all slopes have associated confidence levels of less than 90 per cent.

Mean annual temperatures for Norman Wells A are plotted in Figure 3.5. As might be expected the year-to-year variability is much less than for any monthly time-series. The ten year moving average shows an initial cooling until 1955 and a subsequent 15 year period of slowly increasing temperatures. From 1970 to the present, a much stronger increase is noted. These observations are borne out in the regression analysis where an average increase in annual temperature of 0.018°C is suggested for the entire period of record, and an increase of 0.074°C since 1970. For the longer period, the confidence associated with a positive slope is greater than 90 per cent, but this is not the case for the post-1970 period.

It is instructive to compare the results for Norman Wells A with neighbouring stations. The closest of these is Fort Good Hope, which lies approximately 130 km to the north-west. While the period of record for this station begins in 1945 - only one year after Norman Wells A - the number of years available for analysis is greatly reduced revealing the existence of serious data gaps in the record. In the period after 1970, only about half of the record exists in all months, which renders any direct comparison with the Norman Wells results for that period problematic.

The regression analysis over the entire period of record - which is mostly composed of observations made before 1970 - suggests a cooling trend for the October-March period except for the month of February. This includes the month of January which showed significant warming at Norman Wells A. Fort Good Hope's October and November regression analyses indicate a cooling trend with confidence levels greater than 90 and 95 per cent respectively, which is similar to the results at Norman Wells A. In the summer months at Fort Good Hope, the trends are

definitely towards warmer temperatures. In both June and July the positive trend of mean monthly temperature has a confidence level in excess of 95 per cent. This result is also obtained at Norman Wells A.

The results for Wrigley A, which is located about 275 km up-stream from Norman Wells are summarized in Table 3.1. As was the case with Fort Good Hope, the Wrigley A time-series is not continuous and many gaps exist in the record. In the post-1970 period only the January, December and annual time-series result in regressions in which the confidence level of the slope is greater than 90 per cent. In all cases warming is indicated but the number of years of record (10 for January, 8 for December and 5 for annual temperatures) is so small that conclusions must remain tentative. For the entire period of record no month's trend has a confidence level greater than 90 per cent except October where cooling is indicated with a confidence level of 95 per cent.

Tungsten, located on the Yukon border and at an elevation of 1143 m, does not lie in the Mackenzie Valley at all. As the only station in the Northwest Territories west of the Mackenzie Valley, however, it has its own unique importance. The period of record began only in 1966, and thus cannot be compared with stations in the Mackenzie Valley with records that extend from the mid-forties. While the post-1970 period contains sufficient data gaps to preclude a comparison of annual temperatures, each month is missing at most two data points. A summary of the regression analysis results for Tungsten is given in Table 3.1. Warming in indicated in January and October (95 per cent), and December (90 per cent). These post-70 temperature trends are similar to the Norman Wells A results for the winter months, but the October warming at Tungsten is not observed at Norman Wells.

Burns stated that any climate change in the Mackenzie Valley area would first be noted in winter, and the General Circulation Models project the largest temperature variations in this season as well. Our results for the Norman Wells A station show clear warming trends in winter and summer and cooling trends in the autumn months with confidence levels in each season being about the same. Because the year-to-year variability in winter is much greater than in summer however, the estimate of the year-to-year rate of climate change in winter must also be greater than the summer value for similar confidence levels to be calculated. An attempt to corroborate our findings at Norman Wells A by looking at Fort Good Hope, Wrigley A and Tungsten met with limited success for a variety of reasons. While significant warming trends in summer and cooling in autumn were also observed at Fort Good Hope for the entire period of record, the winter time warming at Norman Wells was not observed at either Fort Good Hope or Wrigley A, and no comparison with Tungsten was possible since observations were not made before 1966.

While post-70 confidence levels at Fort Good Hope and Wrigley are provided in Table 3.1 for completeness, observations after 1970 were not available in sufficient quantity at these stations to make valid comparisons with Norman Wells A. This problem does not occur at Tungsten, where a significant warming trend in winter is observed with

a high degree of confidence, and this tends to corroborate similar results obtained at Norman Wells A. However, Tungsten also indicates an autumn warming which is not observed at Norman Wells A.

3.2.2 The Arctic Coast and Mackenzie Delta Area

Of the four stations in this area, Shingle Point A and Komakuk Beach are on the shores of Mackenzie Bay in the Yukon Territory, Tuktoyaktuk lies on the coast of the Beaufort Sea and Inuvik A is inland and east of the Mackenzie Delta. Unlike the stations in the Norman Wells area, all these stations have approximately the same period of record which commences in 1957-59. Missing data is a problem with all stations except Inuvik, but the problem is not serious enough to pre-empt a comparison of the stations.

Table 3.2 summarizes the results of the regression analysis for the four stations in this area. The Inuvik A time-series plot for January is shown in Figure 3.6. While the year-to-year variance is high for this station, a warming trend of 0.188°C per annum is calculated for the entire period of record, and a similar value of 0.206°C per annum is calculated for the post-1970 period. The level of confidence associated with the long-term warming is greater than 95 per cent, while the confidence of the post-1970 period warming is adversely affected by the very warm January of 1981 and is less than 90 per cent. Similar conclusions are reached for the month of December with significant warming being observed for both the entire period of record and for the period after 1970. Also in March, the post-70 analysis shows a warming trend. In all cases, the level of confidence associated with the positive slope is greater than 90 per cent.

These results for Inuvik A in winter are generally observed at the other stations along the Arctic coast. At Komakuk Beach, only January shows a trend with a confidence level of 90 per cent or better for the entire period of record, while in the post-1970 period, December (90 per cent), February (95 per cent) and March (90 per cent) display this warming trend with high confidence. At Shingle Point A, the post-1970 period of record analysis shows a high degree of confidence for warming in December (90 per cent), January (90 per cent), February (99 per cent) and March (90 per cent), but similar degrees of confidence are only obtained in the entire period of record for January (95 per cent) and February (90 per cent). Finally, at Tuktoyaktuk, January and February temperatures over the entire period of record suggest a warming trend which have confidence levels over 95 per cent; for the post-1970 period of record the months of December (confidence level over 90 per cent), January (90 per cent) and February (99 per cent) have similar warming trends.

April temperatures are shown for Inuvik A in Figure 3.7. Compared with the inter-annual variability, temperature trends are very small, and the confidence level in the sign of the slope (which in this case is negative for both periods of record) is low. Similar conclusions are reached for May at Inuvik A. For the other stations in the area only at Shingle Point A in April for the entire period of record does

the trend have a confidence level greater than 90 per cent, and in this case a cooling is indicated. For all other stations and periods of record the confidence level of the apparent temperature trend is low for the spring months of April and May.

Figure 3.8 shows July temperatures for Inuvik A. While the year-to-year variability is reduced compared with the other seasons, the trends are also very small and the associated level of confidence is low, both for the entire period of record and the post-1970 period. In June, the entire period of record analysis at Inuvik A suggests a warming trend with an associated confidence level of over 90 per cent. At Komakuk Beach a strong warming trend is also observed in June and a similarly strong cooling trend in July for the entire period of record (confidence levels over 99 per cent in both cases). Otherwise, the three month period June-August shows no significant trends for any of the four stations in this area for either the entire period of record or the post-70 period.

Autumn temperatures for the region are typified by the October mean values at Inuvik A which are shown in Figure 3.9. Again, high inter-annual variability, both in the entire period of record and after 1970, reduces the confidence level associated with the calculated trends so that neither warming nor cooling is indicated with any assurance by the data. These conclusions also hold for the other three stations for the months of September, October and November.

Mean annual temperatures are shown for Inuvik A in Figure 3.10. A warming trend is indicated by the ten year moving average as well as the regression analysis. For the entire period of record this trend has a confidence level greater than 90 per cent, but for the post-1970 period this confidence level is not achieved. Identical conclusions are drawn for Tuktoyaktuk except that in this case the confidence level associated with the warming trend over the entire period of record is in excess of 95 per cent. For Shingle Point A, the results are reversed in that only for the post-1970 period is the annual trend up with a confidence level greater than 90 per cent. Finally, at Komakuk Beach neither period of record has a confidence level greater than 90 per cent.

To conclude for the Mackenzie Delta and Arctic coastal areas, a warming trend is evident in winter for both the entire period of record and the post- 1970 period. However, stronger confidence levels are usually obtained for the post-1970 period. In the spring and autumn the results generally coincide with those further south in the Norman Wells area in that no trends are observed with associated confidence levels of greater than 90 per cent. In summer however, the warming trends noted at Norman Wells A are not so strongly observed further north. Annual trends are up at all stations in the Delta and Arctic coastal areas, but the confidence level test produced mixed results. At Inuvik and Tuktoyaktuk, it would appear that the warming has persisted over the entire period of record, while at Shingle Point A, significant warming is suggested only since 1970. At Komakuk Beach no period of record has a warming trend with a confidence level greater than 90 per cent.

3.2.3 The Upper Mackenzie Valley and the Great Slave Lake Area

The southern-most region of the study area contains eight of the sixteen stations which cover a variety of geographical areas. Only one station, Fort Simpson A, is on the Mackenzie River itself, while another, Fort Liard, is on a tributary of the Mackenzie; three stations - Fort Resolution A, Yellowknife A and Hay River A - are situated on the shores of Great Slave Lake; Fort Smith A is located on the Slave River on the Alberta-N.W.T. border, and Fort Chipewyan A and High Level A are in northern Alberta. Despite this variety of geographical location, the results for these stations with respect to temperature trends are in general agreement with one another as will be evident in the following paragraphs. Five of the eight stations in this area have periods of record that extend for several years prior to 1970. Hay River A, Fort Resolution A, Yellowknife A, and Fort Smith A have observations extending from the 1940's while Fort Simpson A began its period of record in 1963. The other stations in the area begin their observing records between 1968 and 1973 and are discussed only with regard to the post-1970 period. In the previous sections the representative surface station also happened to be the location of an upper air station. We will maintain this coincidence in the southern region as well, and show in Figures 3.11-3.15 the temperature plots for Fort Smith A. The results of the regression analysis for the eight southern stations are summarized in Table 3.3.

The time-series of January temperatures for Fort Smith is plotted in Figure 3.11. The ten year moving average shows a gradual warming through the fifties, and a subsequent cooling which ended around 1970; since that time temperatures have been rising once more. Regression analyses show that temperature trends have been up over the post-1970 period by an average of 0.5 °C per annum, and up over the entire period of record by 0.1°C per annum. These analyses also show that in both periods, the confidence that warming has in fact occurred exceeds 95 per cent. The four other long term stations in the region support the conclusion that a winter warming has occurred in the region. For Fort Simpson A, January temperatures over the entire period of record (which began in 1963) are up with a 99 per cent confidence level. January trends are also up at Fort Resolution A, Hay River A and Yellowknife A, but the confidence level is below 90 per cent for the entire period of record in each case. Fort Smith A's February temperatures are also up with a 95 per cent confidence level as are the temperatures at Hay River A and Yellowknife A (confidence of 90 per cent). Hay River A also indicates a warming trend with confidence over 90 per cent in December.

For the post-1970 period only, January temperature trends are positive for all eight stations, and seven of these stations have associated confidence levels exceeding 90 per cent including Fort Resolution A (90 per cent), Fort Smith A, Fort Simpson A, Hay River A and Yellowknife A (95 per cent), and the Alberta stations of High Level A and Fort Chipewyan A (greater than 99 per cent). High confidence levels for the post-1970 period are also achieved for

several stations in the month of December including Fort Simpson A, Hay River A and Fort Liard (all greater than 95 per cent), and Fort Smith A and Yellowknife A (above 90 per cent). Fort Resolution A also has a confidence level exceeding 90 per cent for the post-70 period for the month of February.

The mean April temperature analysis results for Fort Smith A are given in Figure 3.12. While the year-to-year variance is high, a positive trend over the entire period of record is clear from the ten year moving average and the regression analysis which has an associated confidence level of 95 per cent. Also for April and the entire period of record Hay River A and Fort Resolution A are positive with a confidence of 90 per cent, and Yellowknife A is positive with a confidence level of 95 per cent. With regard to other spring months Fort Smith A also shows a positive trend in May with a 95 per cent confidence level, as do Hay River A (90 per cent) and Yellowknife A (95 per cent).

For the post-1970 period Figure 3.12 shows a small increase for Fort Smith A which has a confidence level below 90 per cent. Of the eight stations in the region, four yield positive trend estimates and four, negative estimates for April in the post-1970 period; none of the associated confidence levels exceeds 90 per cent. In May, both Fort Resolution A and High Level A have slope confidence levels exceeding 95 per cent, but the slopes are negative indicating a cooling trend since 1970.

For the summer period (Figure 3.13) we have chosen June instead of July for the Fort Smith A record for reasons that will shortly become apparent. Over the entire period of record, the trend in June at Fort Smith A is positive with an associted confidence level exceeding 90 per cent. At Hay River A and Yellowknife A on Great Slave Lake, temperature increases are also observed but in these cases the confidence levels both exceed 95 per cent. In fact, for Hay River A confidence levels exceeding 90 per cent are seen for April, May and June, and for April, May, June and July for Yellowknife A.

For the post-1970 period in summer, a completely different picture from that of the entire period of record emerges. In Fort Smith A, post-1970 temperatures in June are decreasing with a confidence level that exceeds 99 per cent. This trend is corroborated in Fort Resolution A and Yellowknife A (99 per cent), as well as Hay River A and High Level A (95 per cent). As previously noted, significant negative trends are also observed in May at Fort Resolution A and High Level A (95 per cent), and August cooling is also noted at Fort Resolution A (90 per cent). Only one station shows a positive trend in the post-1970 summer months and that is Fort Liard. Furthermore, this positive trend does not appear to be inconsequential, as it occurs in both June and August and has a confidence level of exceeding 95 per cent in each case.

Figure 3.14 shows the Fort Smith A record for the month of October. No significant trends are noted, either over the entire period of record or in the post-1970 period. This conclusion holds true for the

months of September, October and November for all stations in the region, except for Fort Simpson A in September, which for the entire period of record shows a warming trend with 90 per cent confidence.

Mean annual temperatures for Fort Smith A are plotted in Figure 3.15. The five stations with significant quantities of data prior to 1970 all show a warming trend for mean annual temperatures, and each station has a high degree of confidence associated with this warming trend. For Yellowknife A, the confidence level exceeds 90 per cent, for Fort Resolution A and Hay River A the confidence level exceeds 95 per cent and for Fort Smith A and Fort Simpson A, it exceeds 99 per cent. All the evidence points to a long-term warming in this area over the past 40 years or so. In the post-1970 period, all eight stations in the area show positive trends as well, but the confidence levels are reduced - presumably because of the spring and summer cooling. For Fort Simpson A, the confidence level exceeds 95 per cent, while for Fort Smith A, Fort Resolution A, and Fort Chipewyan A the confidence level now only exceeds 90 per cent.

In summary, winter time temperatures show a clear warming trend in the southern Mackenzie Valley region. Increasing temperatures are also observed in the spring, but only when the period of record includes a significant period prior to 1971. In recent years it would appear that earlier spring warming trends have reduced considerably. In the summer months a warming trend is observed for several stations having pre-1971 data, but an examination of only the post- 1970 data set shows that the trend at most stations has been reversed in recent years so that a significant cooling is now occurring. Fort Liard is an exception to this rule in that the positive trend appears to be continuing at this station with a high degree of confidence. With one single exception the autumn months of September, October and November have no significant warming or cooling trends, either before 1970 or since. Annual trends are clearly up in the past 40 years or so, and less clearly so since 1970.

3.3 RESULTS FOR UPPER AIR TEMPERATURE AND INVERSIONS

Upper air temperature trend analysis is different from the surface analysis for a variety of reasons: first, hourly, rather than daily data are used; secondly, the period of record for upper air data is considerably more restricted than is the case for surface data - Inuvik and Norman Wells upper air data records begin in 1961 while Fort Smith upper air data is available only from 1968. Accordingly, we do not expect the results for the surface measurements of upper air data bases to coincide with results for surface data analysis for the same station. Instead, these surface analyses are used in conjunction with temperatures aloft to draw conclusions about changes in the temperature profile over time.

Results of regression analyses for surface and 85 KPa air temperatures for 00Z and 12Z in Inuvik, Norman Wells and Fort Smith are provided in Appendix 4. An examination of the three stations shows that all significant trends are contained in the Norman Wells results, and these will now be described in detail.

Figures 3.16 shows surface and 85 KPa temperature trends for Norman Wells in January. We recall that in winter 00Z occurs around sunset and 12Z occurs fully seven hours before sunrise. For both times the nocturnal inversion is well established as seen by the fact that 85 KPa temperatures are much warmer than surface values for both ascent times. In terms of year-to-year variation the ten year running means show that since 1970 a gradual warming has occurred at both levels and at both times. This warming cannot be due to industrial activity at the surface since approximately the same rates of increase are also observed about 1200 m above the surface at the 85 KPa level. The confidence level associated with both surface trends and both 85 KPa trends exceeds 95 per cent for Norman Wells in January. December and February temperature trends at Norman Wells are also positive, but in no case does the significance level exceed 90 per cent. At Inuvik, January temperature trends are similar to those in Norman Wells in that all trends are positive with confidence levels greater than 90 per cent. The 12Z surface temperature trend is also positive with high confidence in February, but no other winter temperature trends have confidence levels greater than 90 per cent. At Fort Smith, all temperature trends are positive in January with confidence levels greater than 95 per cent, and both surface temperature trends are positive with confidence levels greater than 90 per cent in February.

In the spring 00Z in Norman Wells occurs in the afternoon five hours before sunset, while 12Z occurs at night approximately two hours before sunrise. Surface and upper temperature trends for Norman Wells for April are shown in Figures 3.17. At 00Z average monthly temperatures decrease with height as one might expect with an afternoon sounding, while at night the nocturnal inversion is maintained, but the thermal gradient in the surface - 85 KPa layer is greatly reduced from its January level. An examination of both the monthly averages and 10 year moving averages shows a high degree of variability - both in terms of mean temperature levels and mean temperature differences between the surface and the 85 KPa level. Regression analyses show positive trends with time for all four time-series, but in no case is the confidence level greater than 90 per cent. In the other spring months, all trends are also positive, but only the 85 KPa temperatures at 00Z in March have an associated confidence level greater than 90 per cent. At both Inuvik and Fort Smith, both warming and cooling trends are observed, but no spring temperature trends have confidence levels greater than 90 per cent.

In summer, (Figures 3.18) the long periods of daylight raise surface temperatures well in excess of their values aloft. The 00Z sounding occurs fully eight hours before sunset at Norman Wells, but the sun has set and risen again before the 12Z sounding is made. Average temperature decreases of over 10°C are observed in the surface

- 85 KPa layer at 00Z - almost double the value observed in April. These large differences cannot be overcome by the few hours that the sun is below the horizon, so that by 12Z surface temperatures are still warmer than the corresponding 85 KPa values - albeit by only 2-3 degrees. For all four time-series trends are very flat, and no significant warming or cooling has apparently occurred. This conclusion also holds true for all three summer months in Norman Wells and Fort Smith as well. In Inuvik, surface temperatures at 00Z have dropped with a confidence level of 90 per cent, but for all other temperatures, levels and ascent times, trends are too small to have a high confidence level that they are not due just to random year-to-year fluctuations.

Autumn time-series of surface and 85 KPa temperatures are shown in Figure 3.19. The 00Z sounding, which occurs about two hours before sunset, shows a high year-to-year variability and a cooling trend at both the surface and 85 KPa levels. Temperatures are reduced with height on average, but the cooling rate is much reduced from its summer values. The regression analyses show that the confidence level associated with the apparent cooling over the past 26 years is below 90 per cent for all four temperatures in October at Norman Wells. Similarly low confidence levels are obtained for September and November, and, with one exception, for all temperature time-series in these three months at Inuvik and Fort Smith as well. The one exception is with September surface temperatures at 12Z in Inuvik where warming has occurred with over 90 per cent confidence.

Mean annual temperatures for Norman Wells are shown in Figures 3.20, and the warming trends are clearly evident for all four time-series. Regression tests show that in all cases the confidence level associated with this warming exceeds 90 per cent. Warming is indicated at the other two stations as well, but with the exception of surface temperatures at 12Z in Inuvik, none of these trends has a confidence level greater than 90 per cent.

In summary, all three upper air stations in the Mackenzie Valley area show clear winter time warming with a high degree of confidence. This warming appears to have occurred at the surface and in the upper atmosphere at least to the 85 KPa level. In the other seasons most trends have low confidence levels suggesting that no conclusions can be made about their sign. In Norman Wells annual temperatures show warming trends at all levels with high confidence, but confidence levels at the other locations are below the 90 per cent level.

The frequency of occurrence of surface and upper-level inversions was examined for any trends that might be evident from the upper air data. For these investigations simple regression analyses are not appropriate since the inversion rate must lie between 0 and 1.

The rate of inversions in January, April, July, October and for the entire year are shown in Figures 3.21 - 3.25. In January, (Figure 3.21) either surface or upper level inversions are usually present during both daily ascents. There is considerable year-to-year variability, but no trends are apparent. In April (Figure 3.22), the increase in daytime heating at the 00Z sounding is apparent in the

sharp drop in inversions, while the 12Z sounding appears to have more surface inversions than was the case in January. Again, however, no time trends are observed. Daytime inversions in July (Figure 3.23) are very rare, but occur in 60-80 per cent of the early morning soundings at 12Z. As with previous months, no lasting trends are noted from year-to-year. Most inversions in October's 00Z sounding are not at the surface, and upper level inversions form a significant fraction of all inversions observed at the 12Z sounding as well. The rate of inversion type shows a high degree of variability from year-to-year, but again no trends are evident. Over the entire year, surface and upper level inversions at 00Z each occur about 20 per cent of the time, while at 12Z, surface inversions occur about 60 per cent of the time, and upper level inversions about 20 per cent of the time. Very little year-to-year variance is observed.

3.4 SNOW DEPTH

In the analysis of surface temperature stations in the same general area showed strong similarities both in year-to-year variability and in the confidence levels of either warming or cooling trends. For snow depth, however, similar levels of spatial correlation cannot be expected. This is due to the fact that snow depth is greatly influenced by the details of local topography which may be expected to cause significant variances over a few hundred metres or more.

Throughout the following analyses snow depth data observed on the last day of the month are used. We will follow the same analysis procedure that was used for temperature for all months in which snow is usually present. Regression analysis results for all stations is presented in Appendix 5, but the text of this report a detailed analysis is presented for three stations in three different areas of the Mackenzie Valley.

3.4.1 The Mid-Valley Region

Of the four stations in the mid-valley region, only Norman Wells A has a sufficient data base for an examination of both pre- and post-1970 periods. Fort Good Hope and Wrigley A have large data gaps in the post-1970 period and Tungsten has no data before 1971.

Mid-winter snow depths for Norman Wells A are shown in Figure 3.26. The ten year moving average shows a maximum snow depth around 1960 which has been decreasing since that time. After 1970 the rate of decrease has been very rapid with some winters having less than 20 cm of snow on the ground on January 31. Late autumn and early snow depths which are represented by November 30 and March 31 snow depths respectively are shown in Figures 3.27 and 3.28. These show similar decreases which become steeper if only the post-1970 data set is considered. Confidence levels associated with all Norman Wells A snow depth trends are very high, exceeding 99 per cent for all six snow months (November- April) for the entire period of record and for five of

the six of these months for the post-1970 period. For the month of April in the post-1970 period, the confidence level is greater than 95 per cent.

The Fort Good Hope data set had many gaps after 1970 - the period for which the Norman Wells A data set showed the most pronounced decreases in snow depth. Perhaps for this reason, the confidence level associated with its trends is not nearly as impressive as is the case for Norman Wells A. Trends for all months are negative, but confidence levels exceed 95 per cent only in December but exceed 90 per cent in November through February. For the other months the rate of decrease is small compared with the year-to-year variability. There is insufficient data in the post-1970 period to make a valid comparison with the Norman Wells A results.

Wrigley A is similar to Fort Good Hope in that it has too many data gaps in the post-1970 period to enable an analysis to be made for this period. For the entire period of record all months except October and April (the beginning and end months of the snow season) indicate decreasing snow depths with time, but only in March is the associated confidence level greater than 90 per cent.

Tungsten's location in the mountains will undoubtedly make its snow depth values quite different from the other stations in the Mackenzie Valley. For the October - December period, Tungsten's data indicates decreasing snow depths, but the confidence levels are very low. In contrast to this, January-April trends are positive and the January and February trends have confidence levels over 90 per cent. All of these results apply to the post-1970 period to which the Tungsten data set is confined.

While the snow depth measurements at Norman Wells Airport are made at a single point there does exist a ten-point snow course which is located approximately 400 m from the airport. Comparisons of snow depth measurements at the Airport and at the snow course for November, January and March are shown in Figures 3.29 - 3.31. Prior to 1980 the agreement is quite good although a few years show large differences. After 1980, however, the snow course measurements are consistently higher than the Airport values. Regression analyses for the post-1970 period for these months show that all trends in the snow course data have very low confidence levels, which would lead one to conclude that snow depth in this period was relatively constant.

3.4.2 The Arctic Coast and Mackenzie Delta Area

Of the four stations in the northern part of the study area, only Inuvik A lies within the Mackenzie Valley, and the other stations lie on the coast of the Arctic Ocean. Inuvik A is therefore, the preferred station from the point of view of this study. The snow season at this far northern station extends from October to April.

The time history of snow depth at Inuvik A is shown in Figures 3.32 - 3.34. Both for the entire period of record and the post-1970 period the trend is for lower snow depths in all seven months of the snow season. However, in the entire period of record, only in December and March are the confidence levels associated with the these negative slopes greater than 90 per cent. In the post-1970 period the confidence levels exceed 90 per cent in October (95 per cent), November and December.

The three Arctic coast stations show results that are very different from those observed at Inuvik A. Shingle Point A data strongly suggests an increasing trend in snow depth in all seven winter months; over the entire period of record the confidence levels associated with these trends are greater than 90 per cent in all months except April, while over the post-1970 period of record, confidence levels exceed 90 per cent in all months except October and November. At neighbouring Komakuk Beach, the entire period of record shows a mixture of positive and negative trends with confidence levels in excess of 90 per cent for increasing snow depths in November and December. For the post- 1970 period, trends are uniformly positive with confidence levels exceeding 90 per cent in December (95 per cent), January, February and March. Finally, the Tuktoyaktuk data set shows mostly positive trends over the entire period of record, but the associated confidence levels for all months are low. In the post-1970 period all trends are negative as was the case with Inuvik, with confidence levels exceeding 90 per cent in November and the January - March period.

A 10 point snow course exists near the Inuvik A station, and its data are compared with Inuvik A snow depths in Figures 3.35 - 3.37. In general, the sharp peaks associated with high year-to-year variance in the airport data are greatly attenuated in the snow course data. If we replace observations at the Airport with snow course data in January, March and November whenever the latter are available then regressions over the entire period of record show that the negative trends in November and January now have confidence levels greater than 90 per cent. Over the post-1970 period, confidence levels exceed 90 per cent in November and March.

In summary, the stations of Inuvik and Tuktoyaktuk tend to show decreased snow depths with time with stronger negative trends since 1970 than over the entire period of record. Shingle Point A and Komakuk Beach data, on the other hand, suggest that snow depths have been increasing both over the entire period of record and since 1970.

3.4.3 The Upper Mackenzie Valley and the Great Slave Lake Area

Of the eight stations in this area used for temperature analyses, only Fort Simpson A, Fort Resolution A, Hay River A, Yellowknife A, and Fort Smith A have a sufficient snow depth data base before 1970 to be useful, while only Fort Simpson A, Hay River A, Yellowknife A, High Level A, Fort Chipewyan A and Fort Smith A have sufficient post-1970 data for analysis.

Snow depth time-series and their associated ten year running mean values and best-fit regression lines for Fort Smith A are shown in Figures 3.38 - 3.40. As suggested in these figures there is a high year-to-year variability with no significant trend in any month for either the entire period of record or for the post-1970 period.

When other stations in this area indicate a high level of confidence in the estimated snow depth trend with time, the trend is usually negative. Over the entire period of record, the three stations around Great Slave Lake all show decreased snow depths with confidence levels exceeding 95 per cent for all three winter months (except Fort Resolution A in January), and Yellowknife A data indicates that snow depth has decreased in all months in the post-1970 period as well with confidence levels exceeding 95 per cent in November, December, January and March. Also for the post-1970 period, Fort Chipewyan A indicates falling snow levels in all months and more than 90 per cent confidence in January, February and March.

Figures 3.41 - 3.43 show the comparison of Fort Smith airport snow depth data with that of the nearby 10 point snow course. While the observations at the two stations are often quite different, conclusions regarding trends for the Fort Smith area are not changed with the additional data.

Snow depths in the southern part of the Mackenzie Valley would seem to have decreased in the past 40 years as well as in the period since 1970. Only on the Arctic coast is there consistent evidence that snow depths are increasing, and this evidence is confined to Komakuk Beach and Shingle Point A and is refuted somewhat by Tuktoyaktuk. A comparison of 10 point snow course and nearby airport data at Fort Smith, Norman Wells and Inuvik shows the high degree of spatial variability to which snow depth measurements are subject. Year-to-year variability is also evident in the time-series plots.

TABLE 3.1 Significance levels of the slope of the best linear fit mean surface temperature time series for stations in the mid-Mackenzie Valley region by month and for the year.

--- Negative slope with significance level greater than 99%
-- Negative slope with significance level greater than 95%
- Negative slope with significance level greater than 90%
+ Positive slope with significance level greater than 90%
++ Positive slope with significance level greater than 95%
+++ Positive slope with significance level greater than 99%

STATION	PERIOD OF RECORD	MONTH JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
NORMAN WELLS	ALL	+	.	.	.	.	++	++	.	+	-	-	.	+
	71-	+	.	.	.	.	.	.	.	.	.	.	++	.
FT GOOD HOPE	ALL	.	.	-	.	.	++	++	.	.	-	--	.	.
	71-	++	++	.	.	.	.	.	.	++	.	.	--	.
WRIGLEY A	ALL	.	.	.	.	.	.	.	.	.	--	.	.	.
	71-	+++	.	.	.	.	.	.	.	.	.	.	++	+++
TUNGSTEN	ALL	+++	.	.	.	.	-	++	.	.	++	.	.	++
	71-	++	.	.	.	.	.	.	.	.	++	.	+	++

TABLE 3.2 Significance levels of the slope of the best linear fit mean surface temperature time series for stations in the Mackenzie Delta - Arctic coast region by month and for the year.

--- Negative slope with significance level greater than 99%
-- Negative slope with significance level greater than 95%
- Negative slope with significance level greater than 90%
+ Positive slope with significance level greater than 90%
++ Positive slope with significance level greater than 95%
+++ Positive slope with significance level greater than 99%

STATION		MONTH JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
INUVIK A	ALL	++	.	.	.	.	+	.	.	.	.	.	+	+
	71-	.	.	+	.	.	.	.	.	.	.	.	+	.
KOMAKUK	ALL	+	.	.	.	.	+++	---	.	.	.	.	.	.
	71-	.	+++	+	.	.	.	.	.	.	.	.	+	.
SHINGLE PT	ALL	++	+	.	-	.	.	.	.	.	.	.	.	.
	71-	+	+++	+	.	.	.	.	.	.	.	.	++	+
TUKTOYAKTUK	ALL	++	++	.	.	.	.	.	.	.	.	.	.	++
	71-	+	+++	.	.	.	.	.	.	.	.	.	+	.

TABLE 3.3 Significance levels of the slope of the best linear fit mean surface temperature time series for stations in the lower valley - Great Slave lake region by month and for the year.

--- Negative slope with significance level greater than 99%
-- Negative slope with significance level greater than 95%
- Negative slope with significance level greater than 90%
+ Positive slope with significance level greater than 90%
++ Positive slope with significance level greater than 95%
+++ Positive slope with significance level greater than 99%

STATION		MONTH JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
FORT SMITH A	ALL	++	++	.	++	++	+	.	.	.	.	.	.	+++
	71-	++	.	.	.	.	---	.	.	.	.	.	+	+
FT RESOL A	ALL	.	.	.	+	.	.	.	.	.	.	.	.	++
	71-	+	+	.	.	--	---	.	-	.	.	.	.	+
FT SIMPSON A	ALL	+++	.	.	.	.	.	.	.	+	.	.	.	+++
	71-	++	.	.	.	.	.	.	.	.	.	.	++	++
HAY RIVER A	ALL	.	+	.	+	+	++	.	.	.	.	.	+	++
	71-	++	.	.	.	.	--	.	.	.	.	.	++	.
YELLOWKNIFE	ALL	.	+	.	++	++	++	+	.	.	.	.	.	+
	71-	++	.	.	.	.	---	.	.	.	.	.	+	.
HIGH LEVEL A	71-	+++	.	.	.	--	--	.	.	.	.	.	.	.
FORT CHIP A	68-	+++	.	.	.	.	.	.	.	.	.	.	.	+
FORT LIARD	73-	.	.	.	.	.	++	.	++	.	.	.	++	.

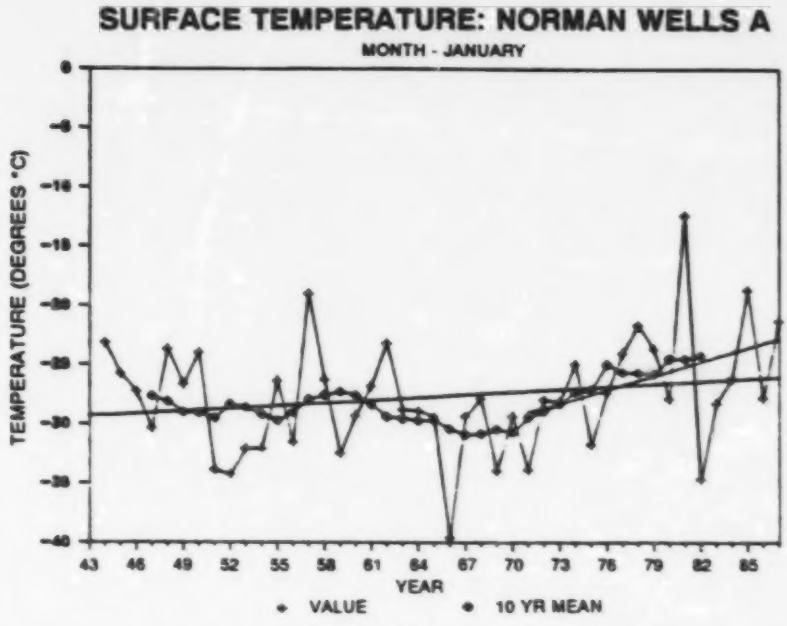

SURFACE TEMPERATURE: NORMAN WELLS A
MONTH - JANUARY
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
VALUE
10 YR MEAN

Figure 3.1: Mean monthly air temperature time series for Norman Wells A in January. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

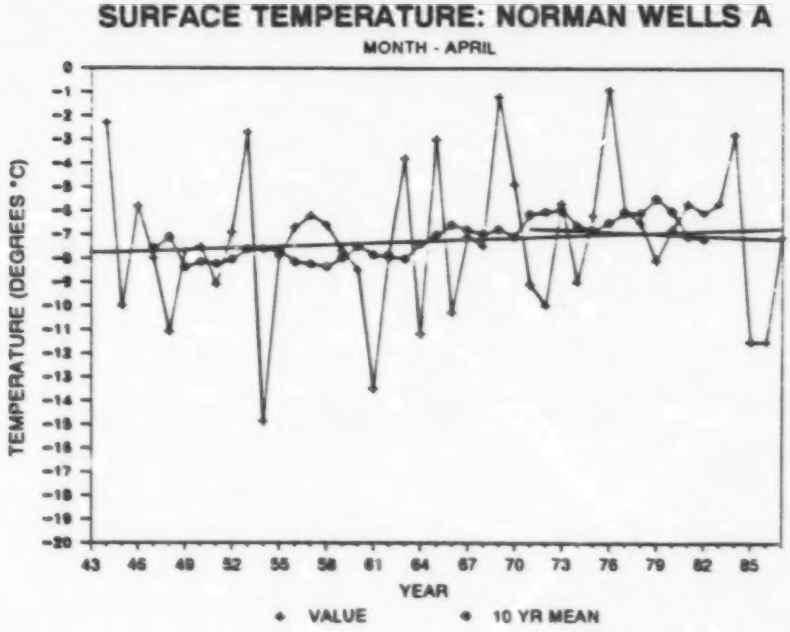

SURFACE TEMPERATURE: NORMAN WELLS A
MONTH - APRIL
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
VALUE
10 YR MEAN

Figure 3.2: Mean monthly air temperature time series for Norman Wells A in April. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

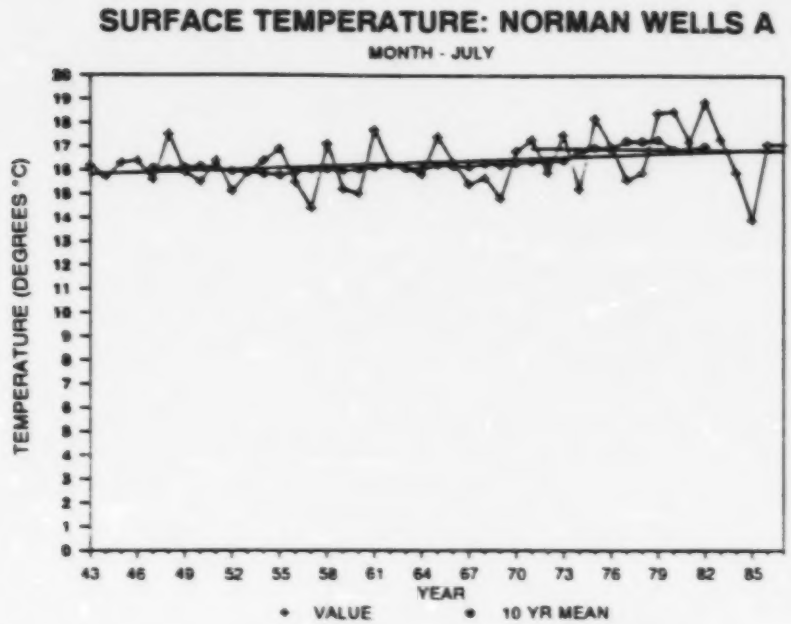

SURFACE TEMPERATURE: NORMAN WELLS A
MONTH - JULY
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
VALUE
10 YR MEAN

Figure 3.3: Mean monthly air temperature time series for Norman Wells A in July. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

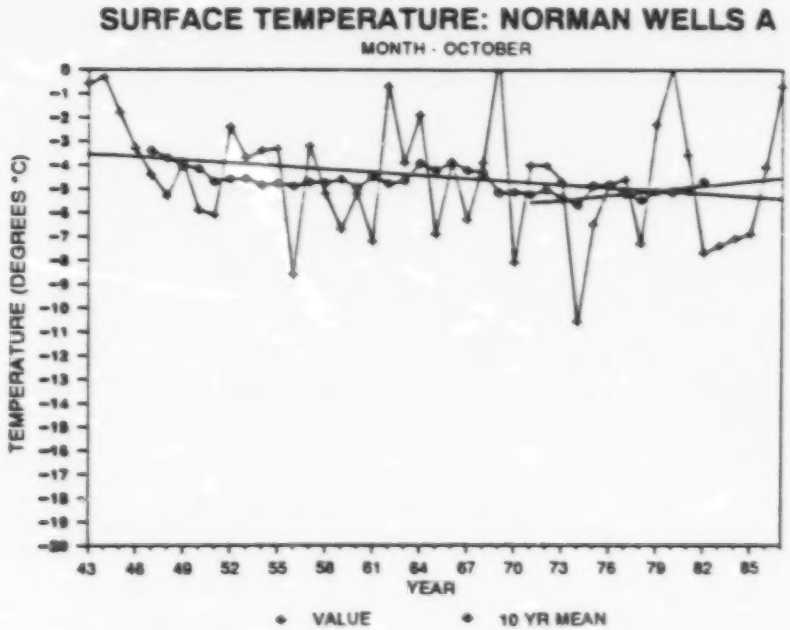

SURFACE TEMPERATURE: NORMAN WELLS A
MONTH - OCTOBER
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
VALUE
10 YR MEAN

Figure 3.4: Mean monthly air temperature time series for Norman Wells A in October. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

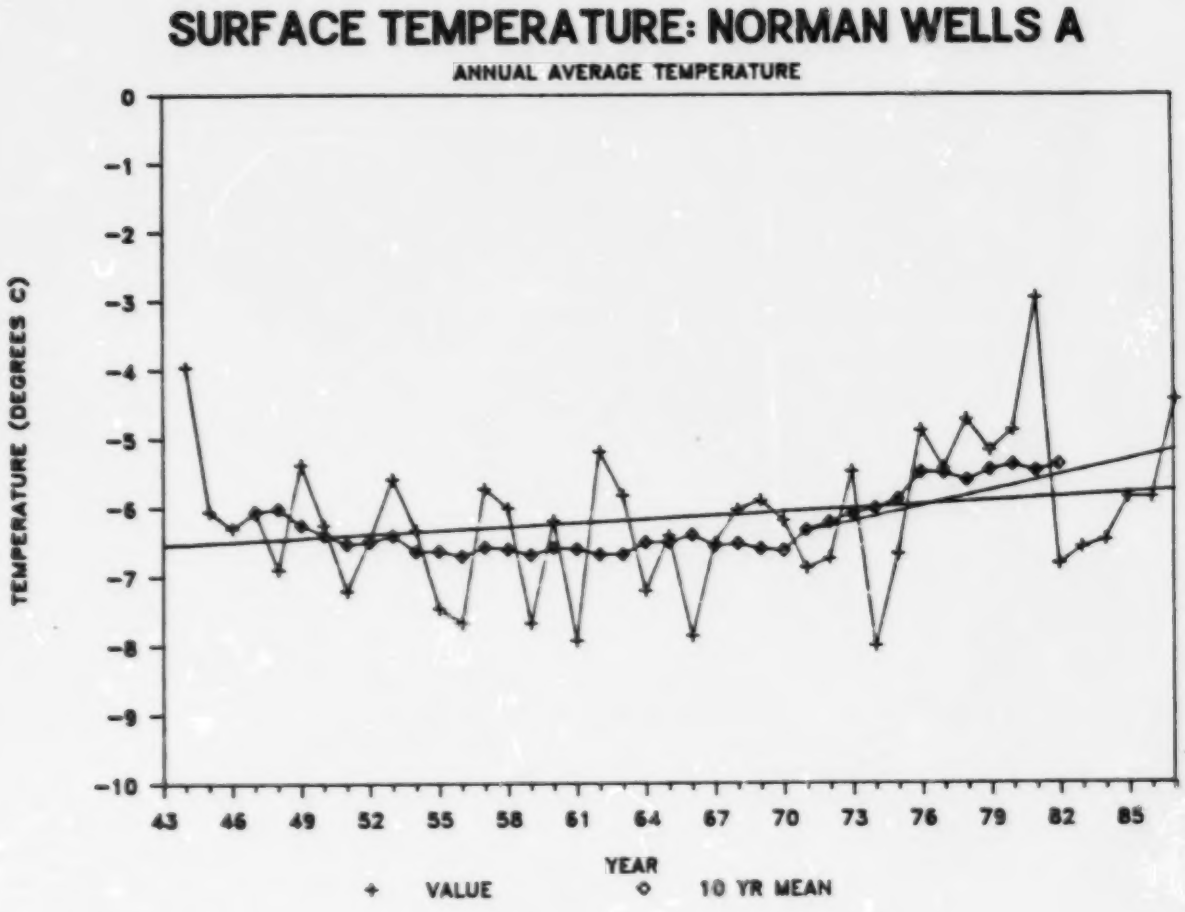


Figure 3.5: Mean annual air temperature time series for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

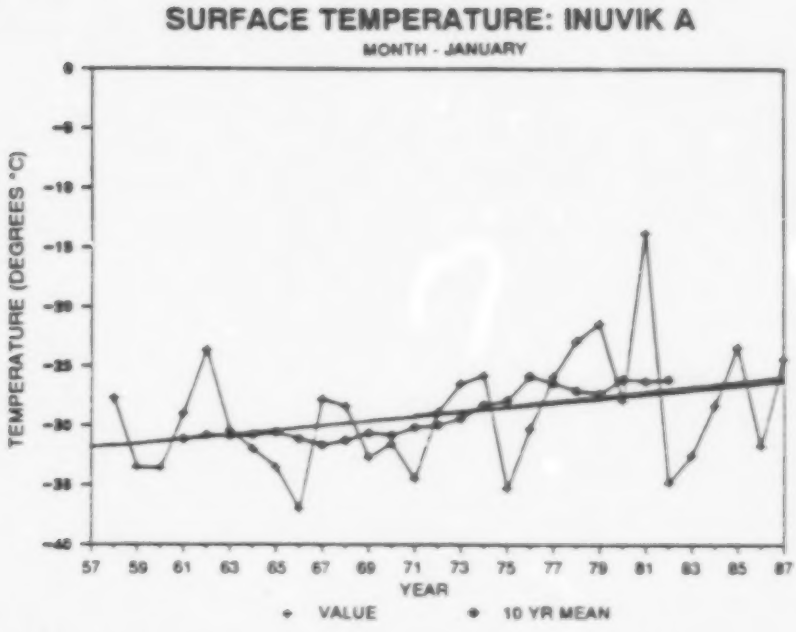

SURFACE TEMPERATURE: INUVIK A
MONTH - JANUARY
TEMPERATURE (DEGREES °C)
YEAR
57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87
VALUE
10 YR MEAN

Figure 3.6: Mean monthly air temperature time series for Inuvik A in January. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

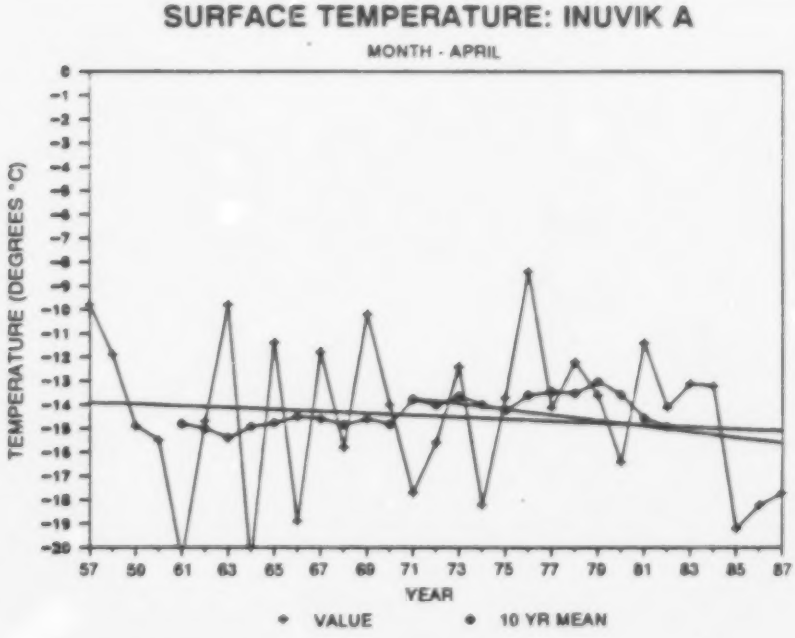

SURFACE TEMPERATURE: INUVIK A
MONTH - APRIL
TEMPERATURE (DEGREES °C)
YEAR
57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87
VALUE
10 YR MEAN

Figure 3.7: Mean monthly air temperature time series for Inuvik A in April. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

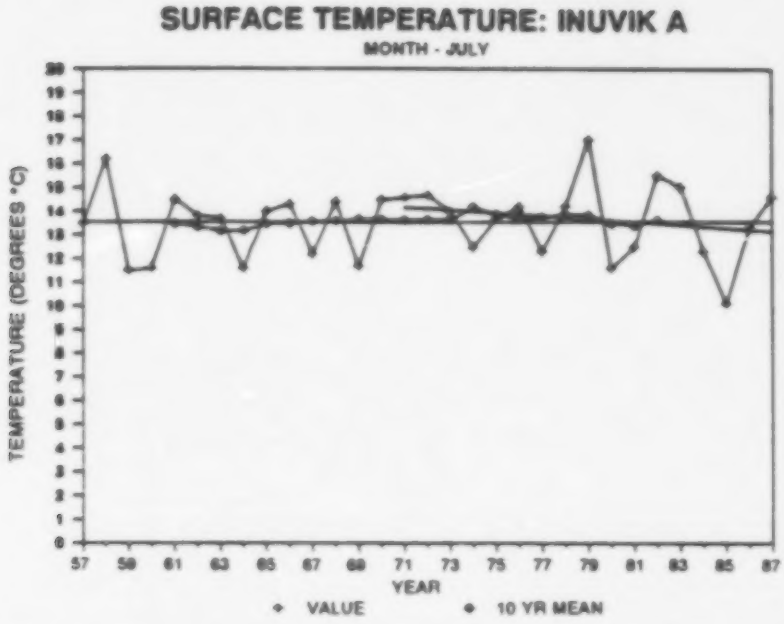


Figure 3.8: Mean monthly air temperature time series for Inuvik A in July. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

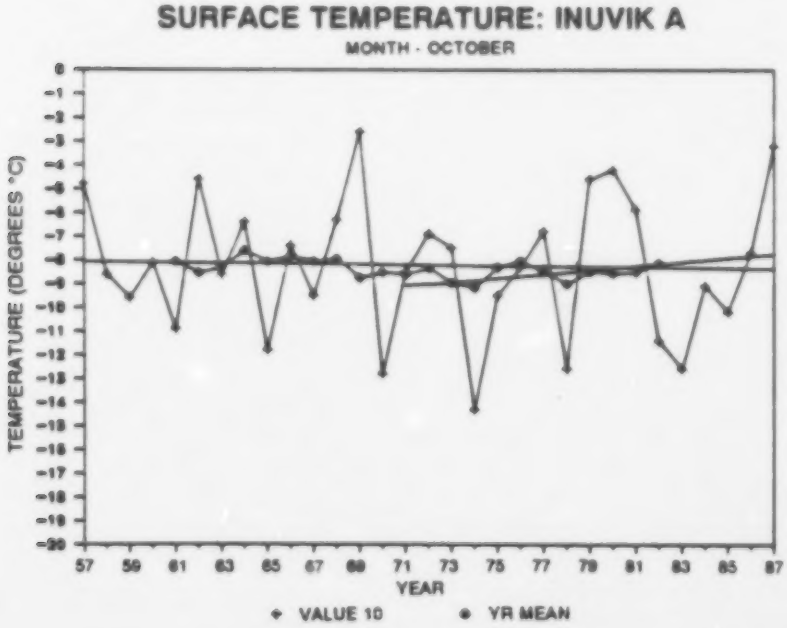


Figure 3.9: Mean monthly air temperature time series for Inuvik A in October. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

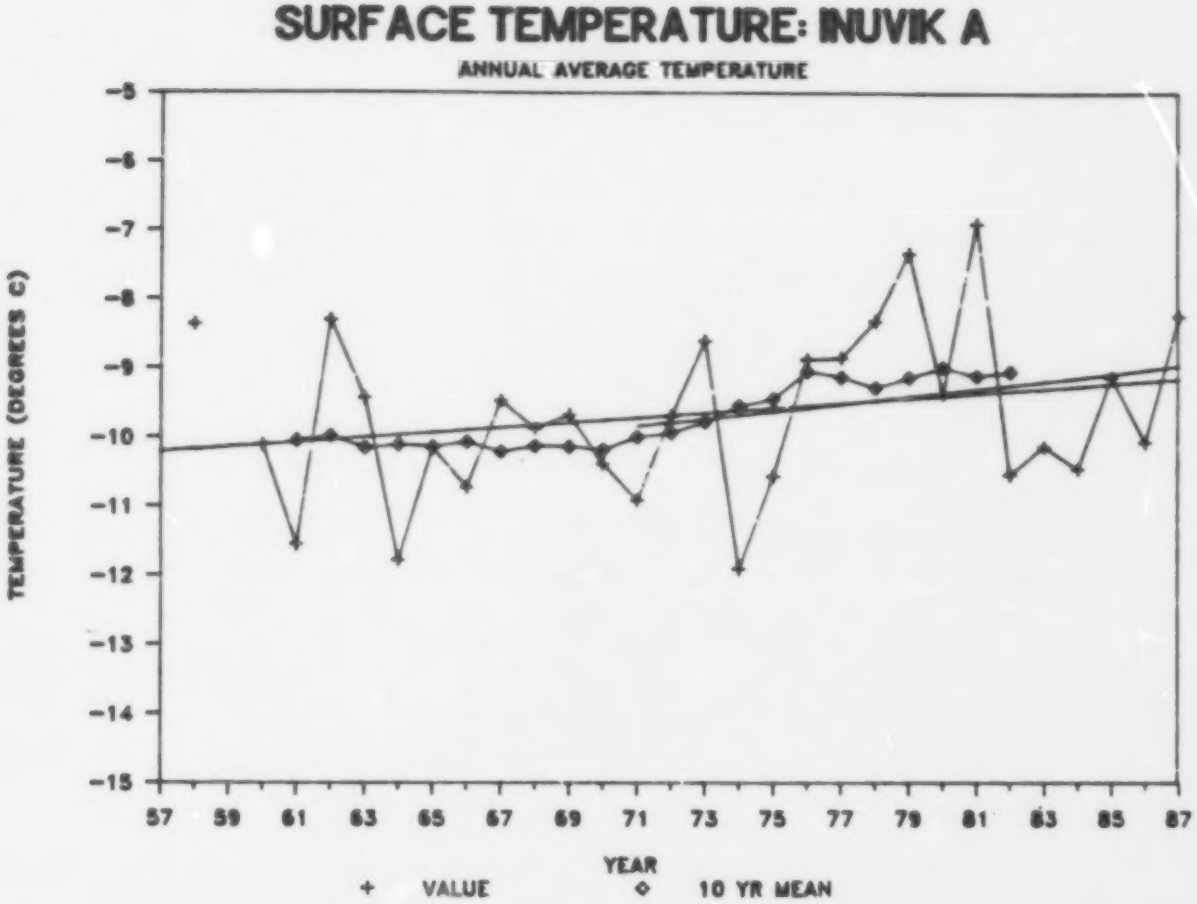


Figure 3.10: Mean annual air temperature time series for Inuvik A. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

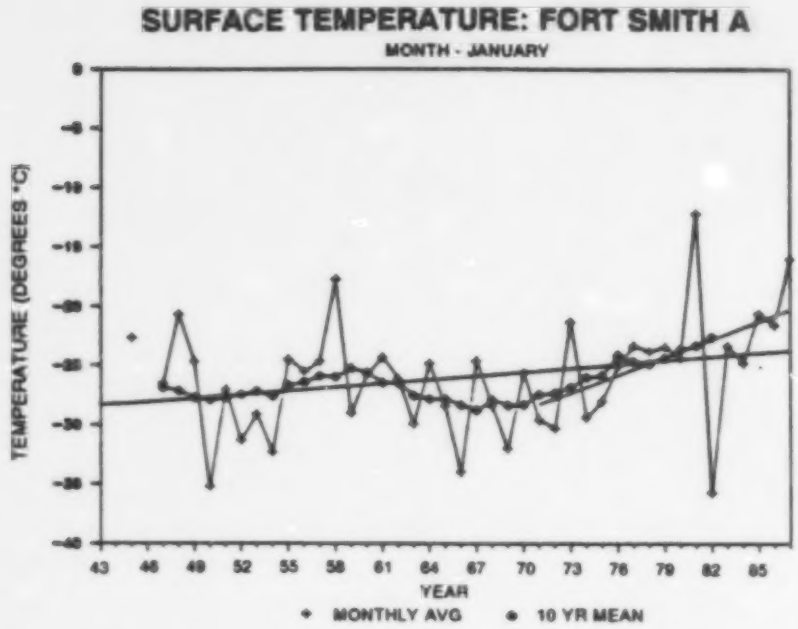


Figure 3.11: Mean monthly air temperature time series for Fort Smith A in January. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

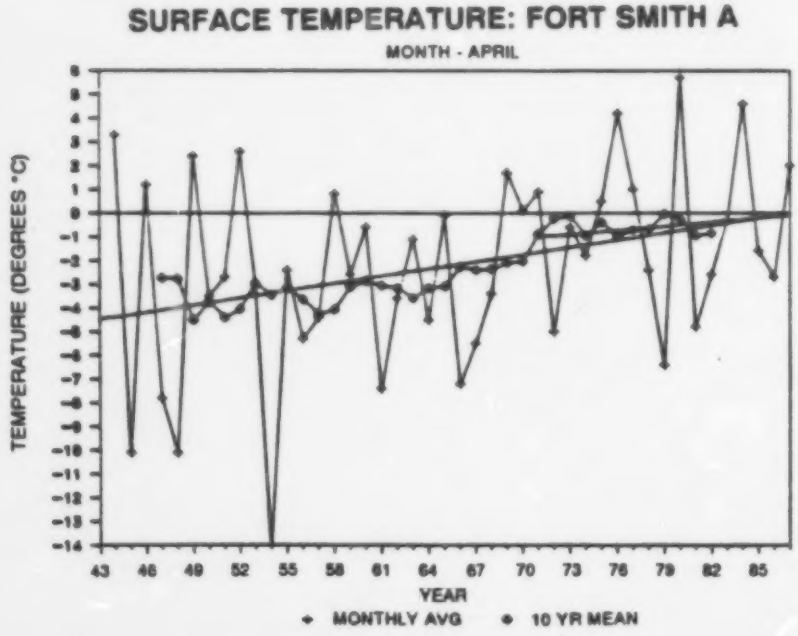


Figure 3.12: Mean monthly air temperature time series for Fort Smith A in April. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

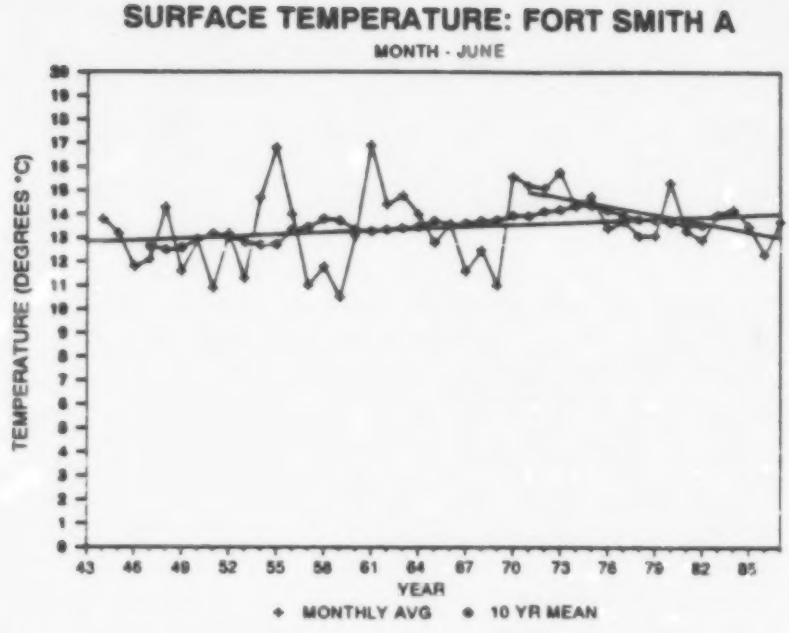

SURFACE TEMPERATURE: FORT SMITH A
MONTH - JUNE
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
◆ MONTHLY AVG ● 10 YR MEAN

Figure 3.13: Mean monthly air temperature time series for Fort Smith A in June. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

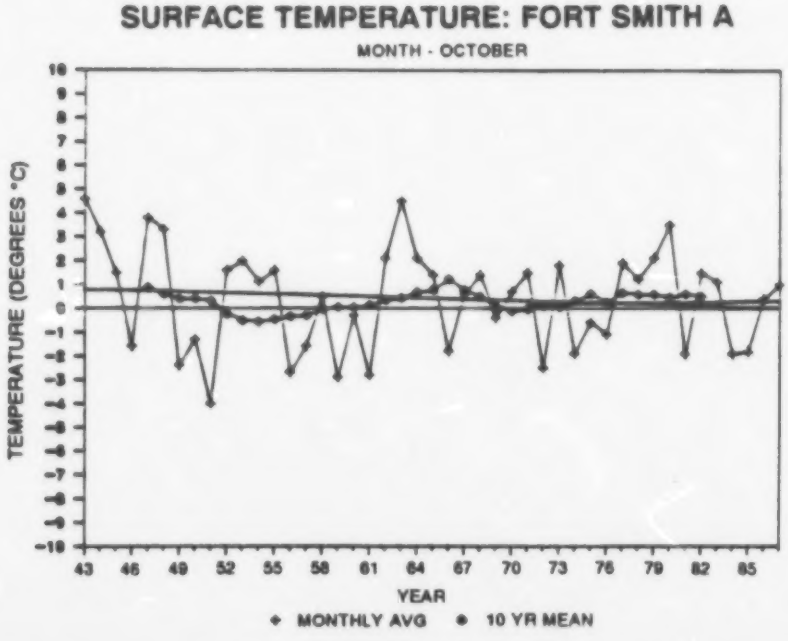

SURFACE TEMPERATURE: FORT SMITH A
MONTH - OCTOBER
TEMPERATURE (DEGREES °C)
YEAR
43 46 49 52 55 58 61 64 67 70 73 76 79 82 85
◆ MONTHLY AVG ● 10 YR MEAN

Figure 3.14: Mean monthly air temperature time series for Fort Smith A in October. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

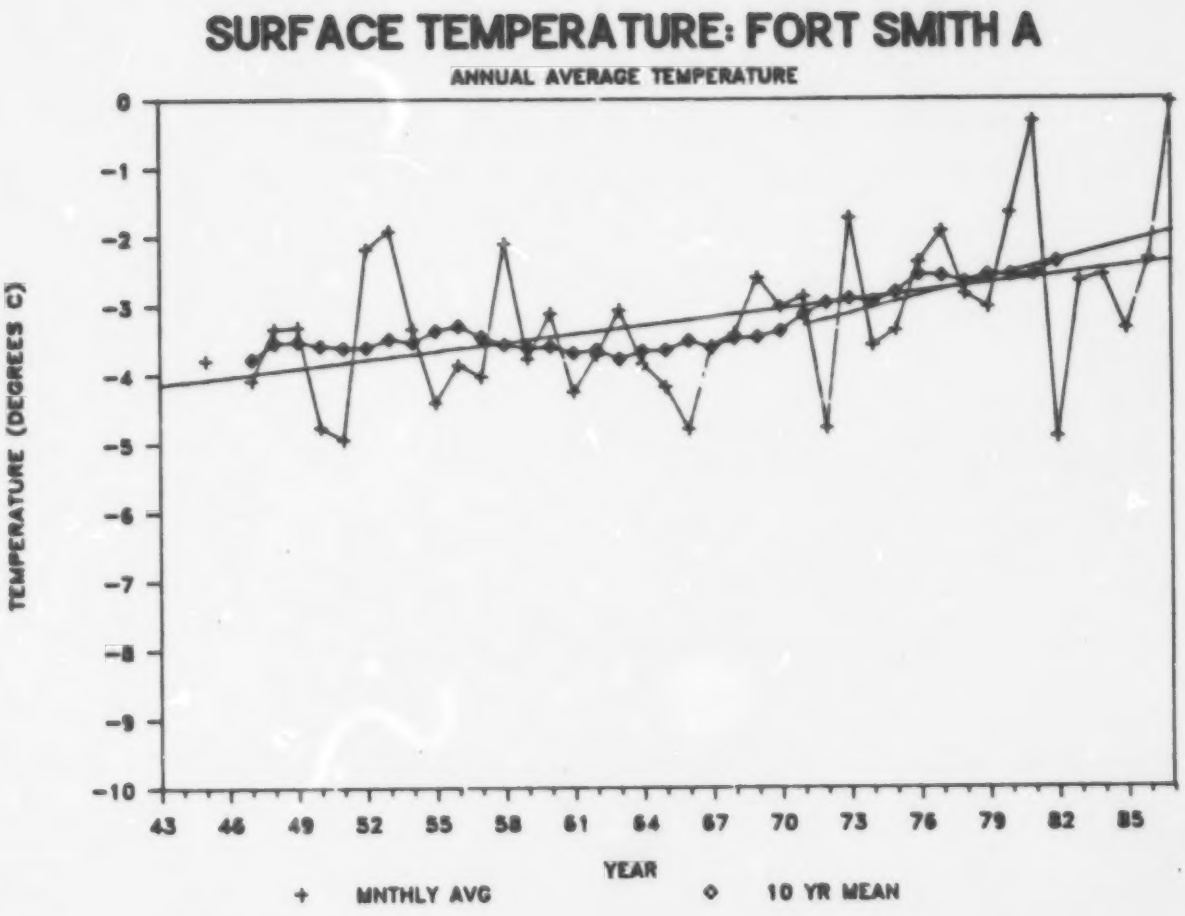


Figure 3.15: Mean annual air temperature time series for Fort Smith A. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

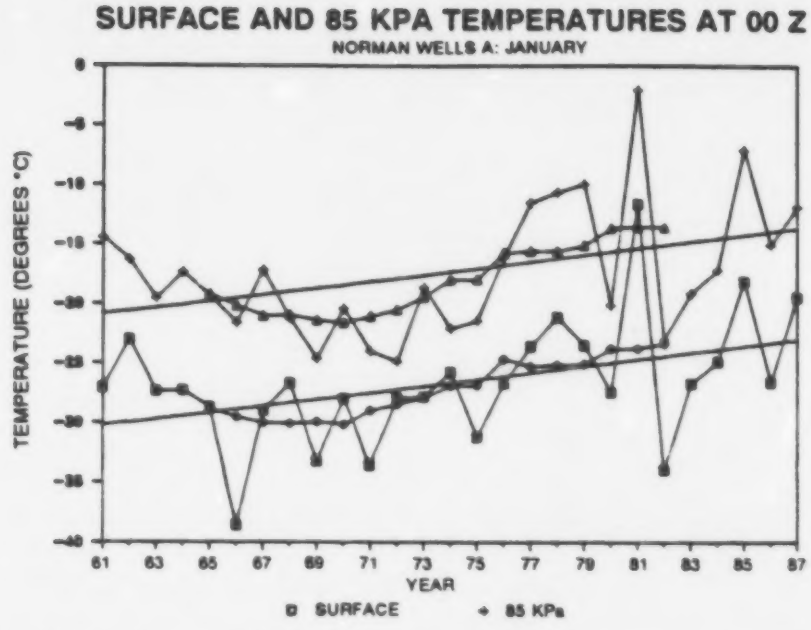


Figure 3.16a: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 0 Z in January for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

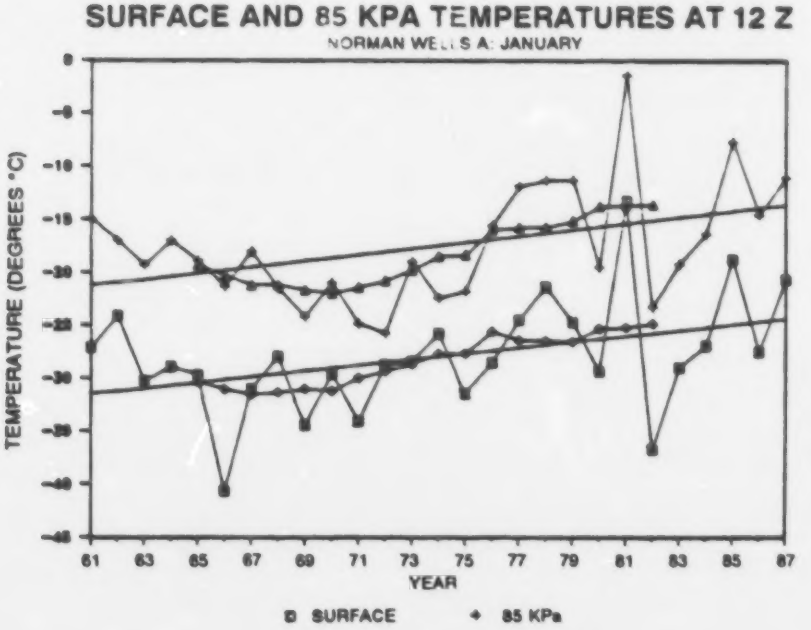


Figure 3.16b: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 12 Z in January for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

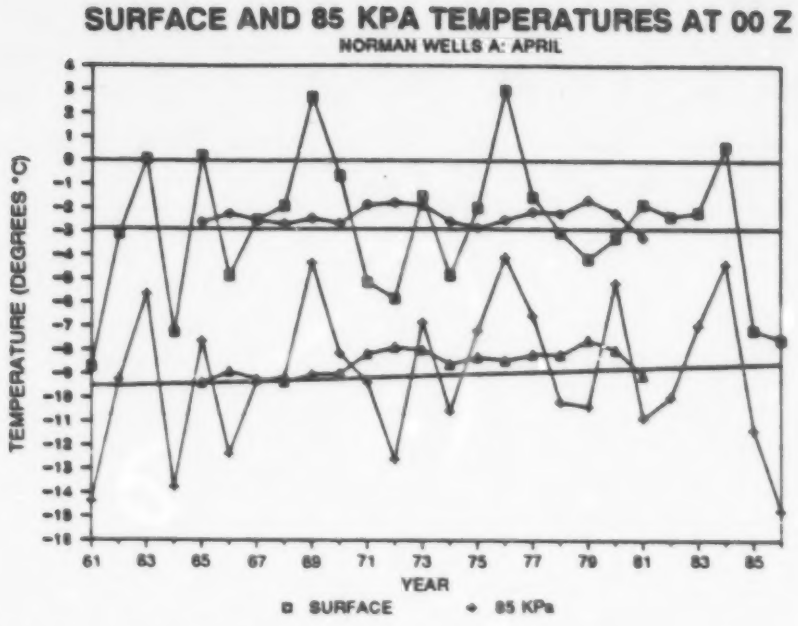


Figure 3.17a: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 0 Z in April for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

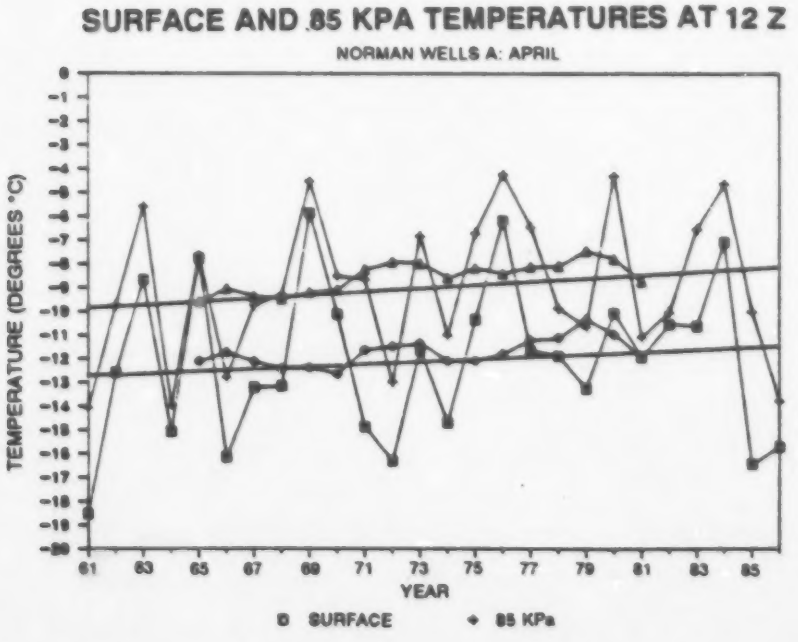


Figure 3.17b: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 12 Z in April for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

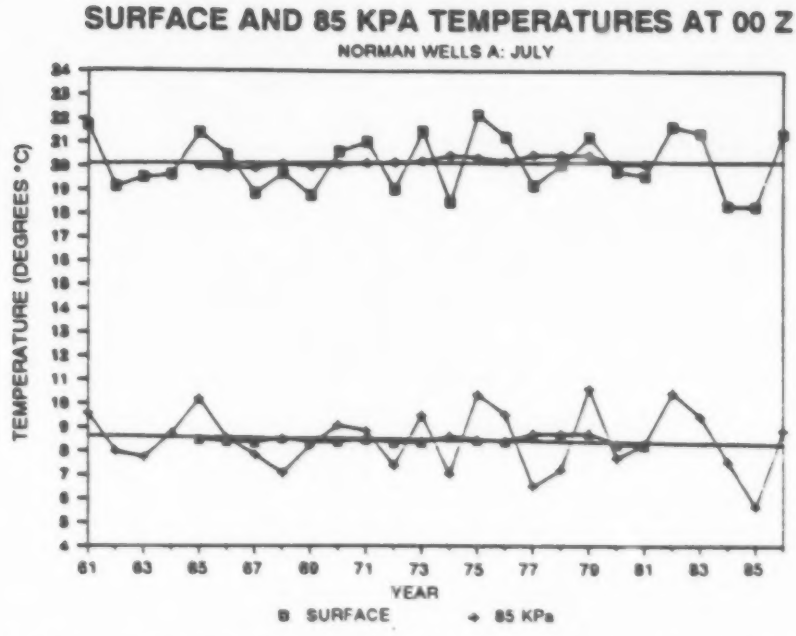


Figure 3.18a: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 0 Z in July for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

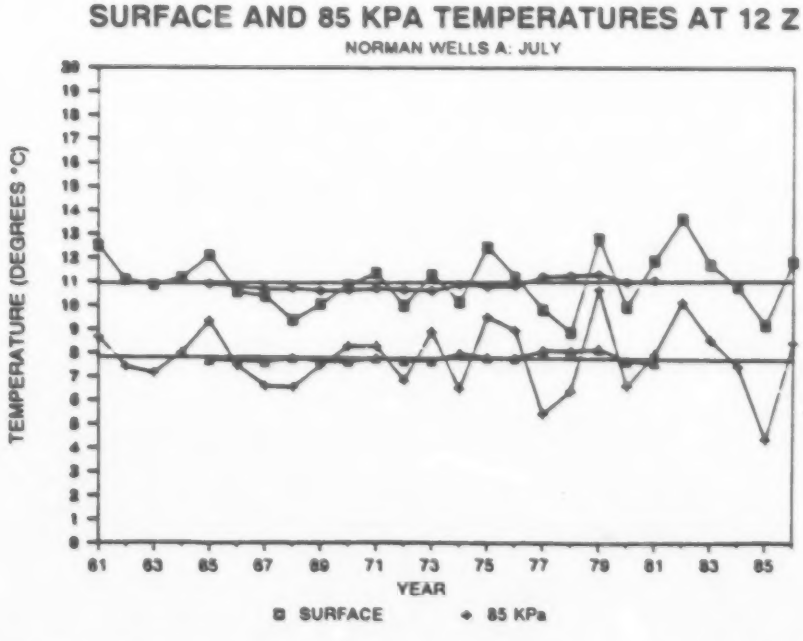


Figure 3.18b: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 12 Z in July for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

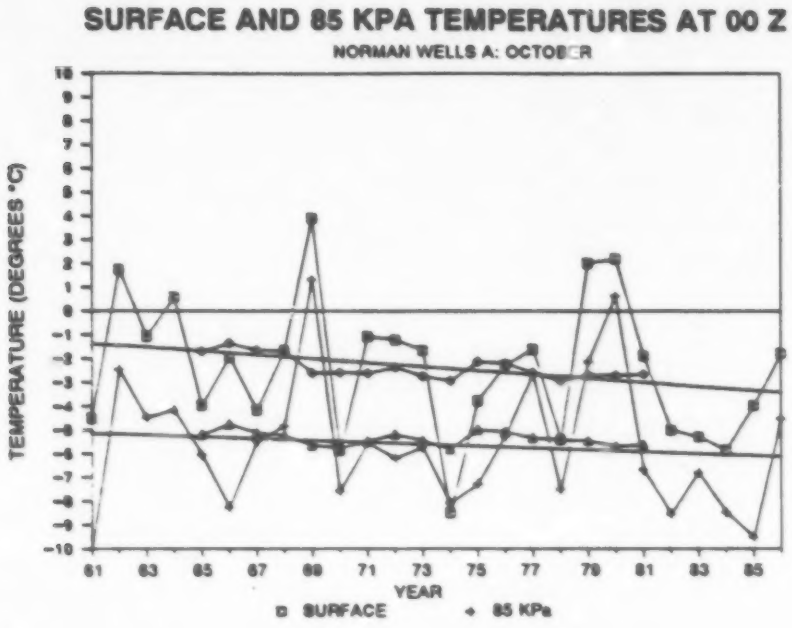

SURFACE AND 85 KPA TEMPERATURES AT 00 Z
NORMAN WELLS A: OCTOBER
TEMPERATURE (DEGREES °C)
YEAR
61 63 65 67 69 71 73 75 77 79 81 83 85
SURFACE
85 KPa

Figure 3.19a: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 0 Z in October for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

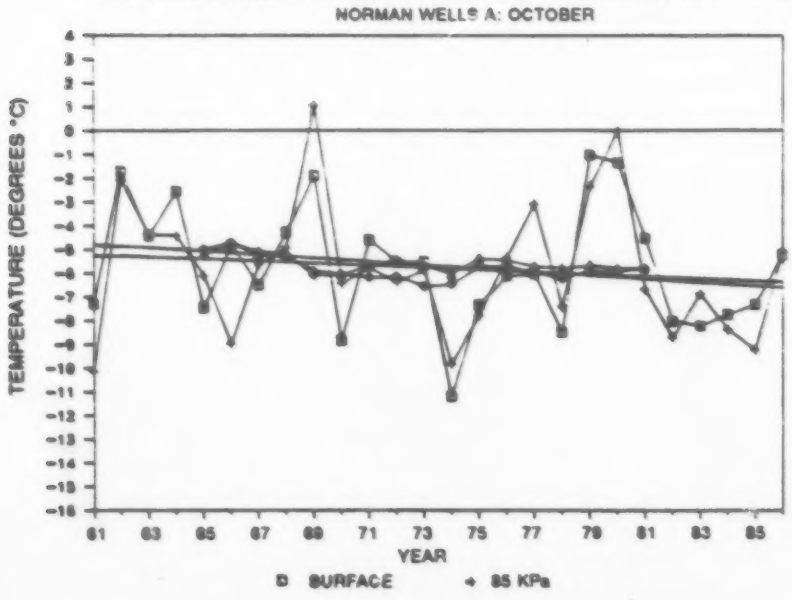

SURFACE AND 85 KPA TEMPERATURES AT 12 Z
NORMAN WELLS A: OCTOBER
TEMPERATURE (DEGREES °C)
YEAR
61 63 65 67 69 71 73 75 77 79 81 83 85
SURFACE
85 KPa

Figure 3.19b: Mean monthly air temperature time series are given for surface and 85 KPa level observations at 12 Z in October for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

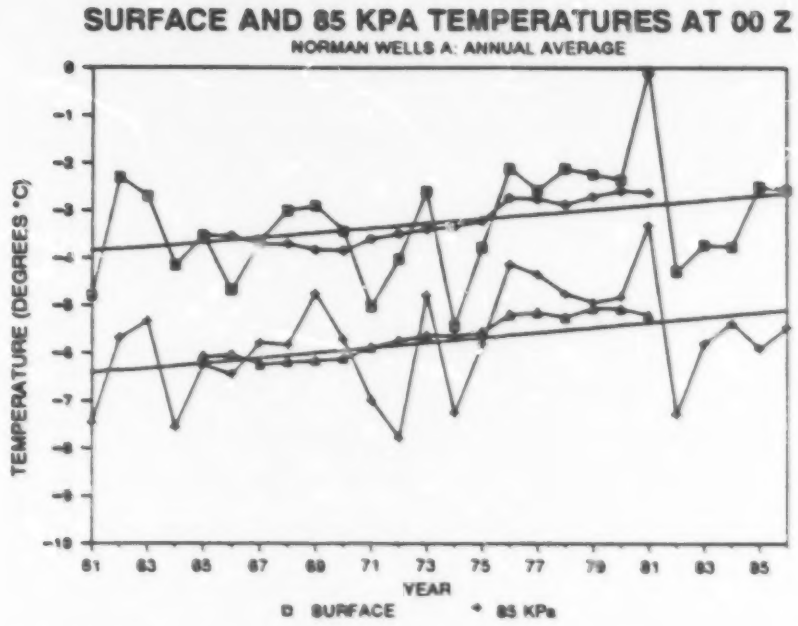


Figure 3.20a: Mean annual air temperature time series are given for surface and 85 KPa level observations at 0 Z for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

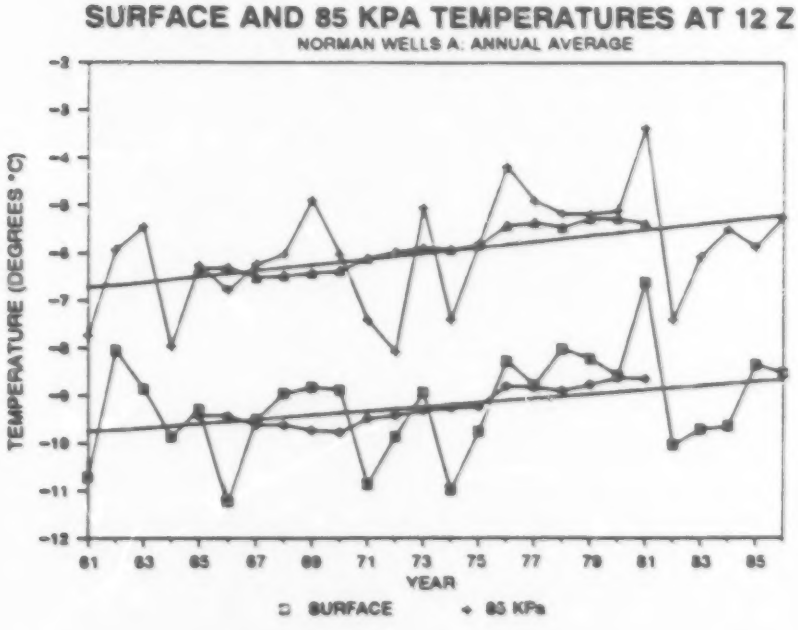


Figure 3.20b: Mean annual air temperature time series are given for surface and 85 KPa level observations at 12 Z for Norman Wells A. Also shown are the time series of 10 year running mean values and the best-fit straight line for the entire period of record.

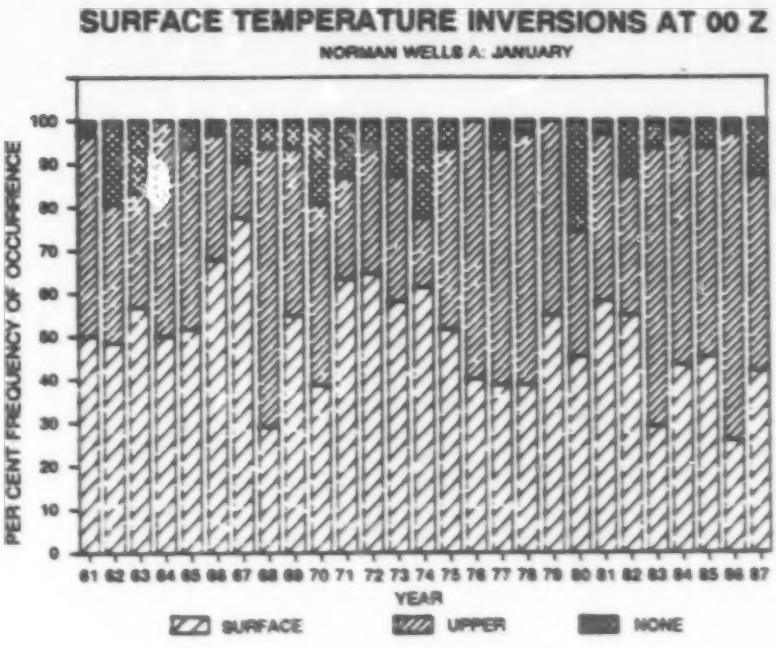

SURFACE TEMPERATURE INVERSIONS AT 00 Z
NORMAN WELLS A: JANUARY
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87
YEAR
SURFACE
UPPER
NONE

Figure 3.21a: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 0 Z in January.

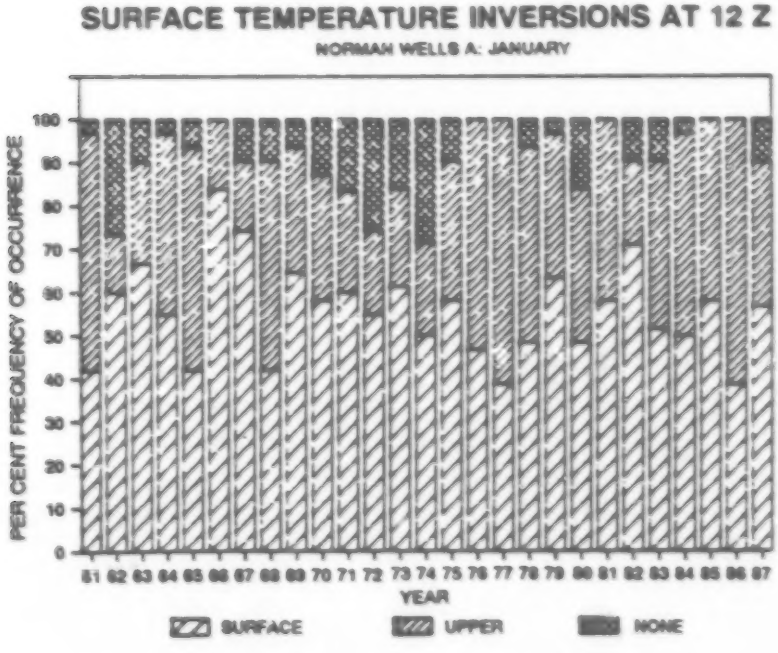

SURFACE TEMPERATURE INVERSIONS AT 12 Z
NORMAN WELLS A: JANUARY
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87
YEAR
SURFACE
UPPER
NONE

Figure 3.21b: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 12 Z in January.

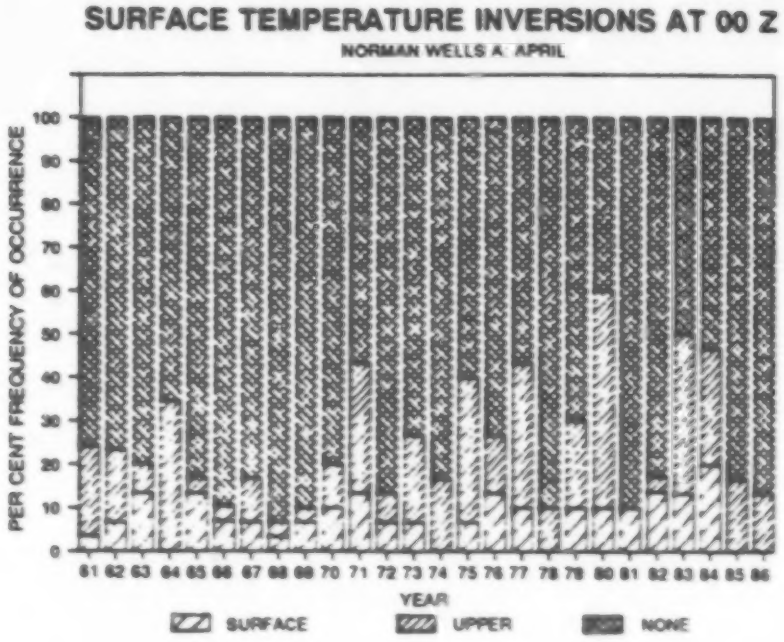


Figure 3.22a: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 0 Z in April.

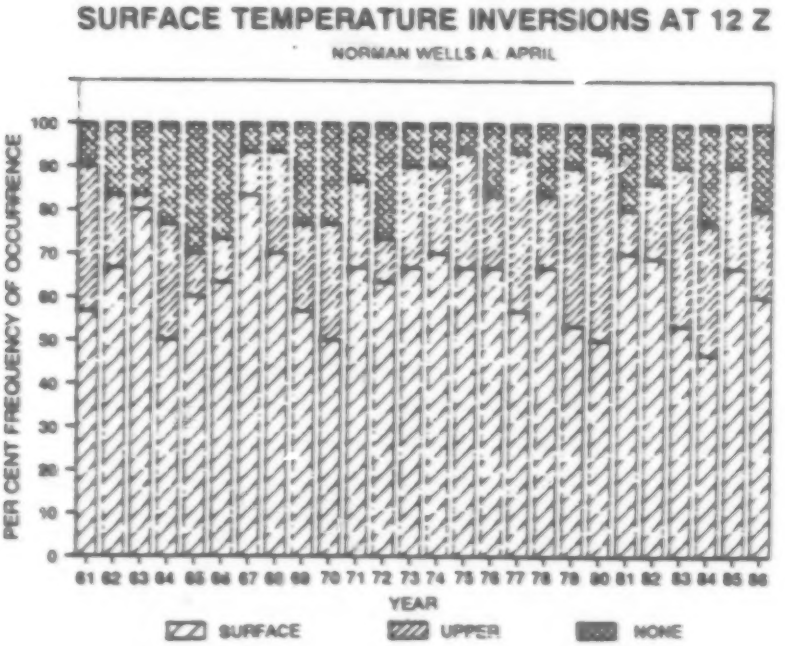


Figure 3.22b: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 12 Z in April.

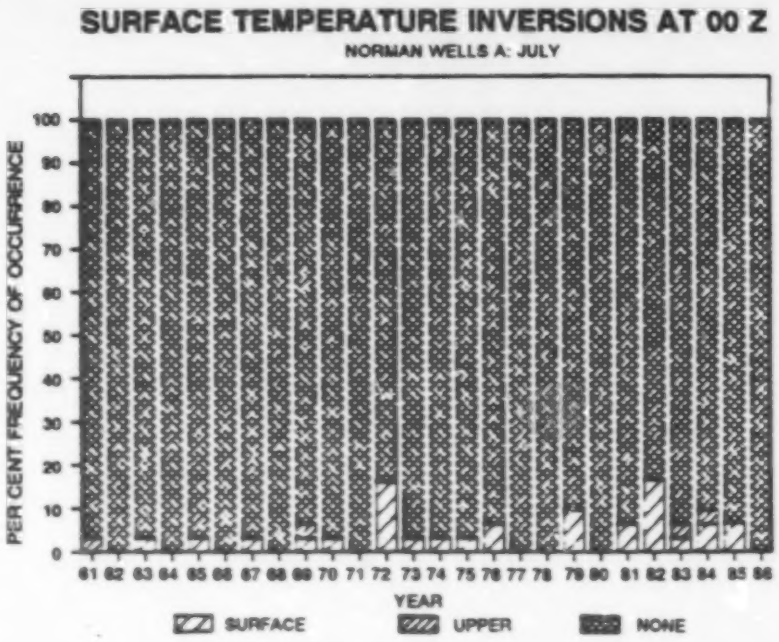


Figure 3.23a: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 0 Z in July.

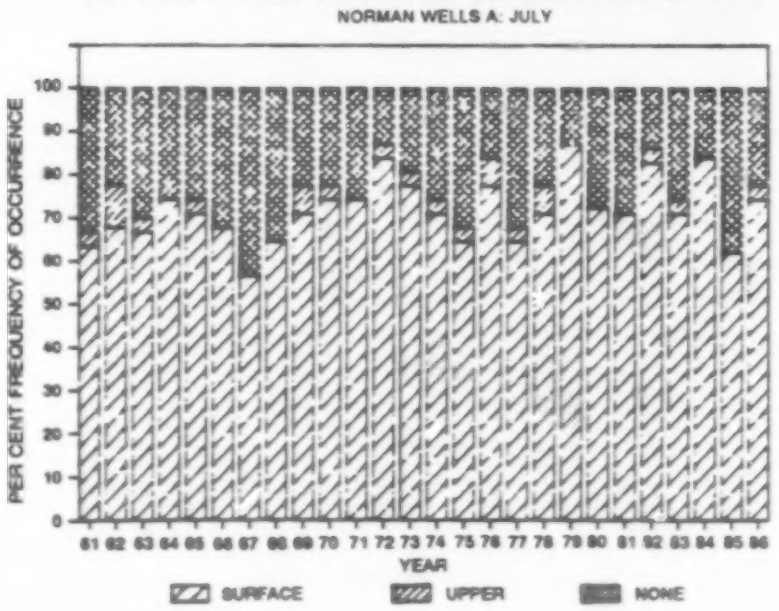


Figure 3.23b: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 12 Z in July.

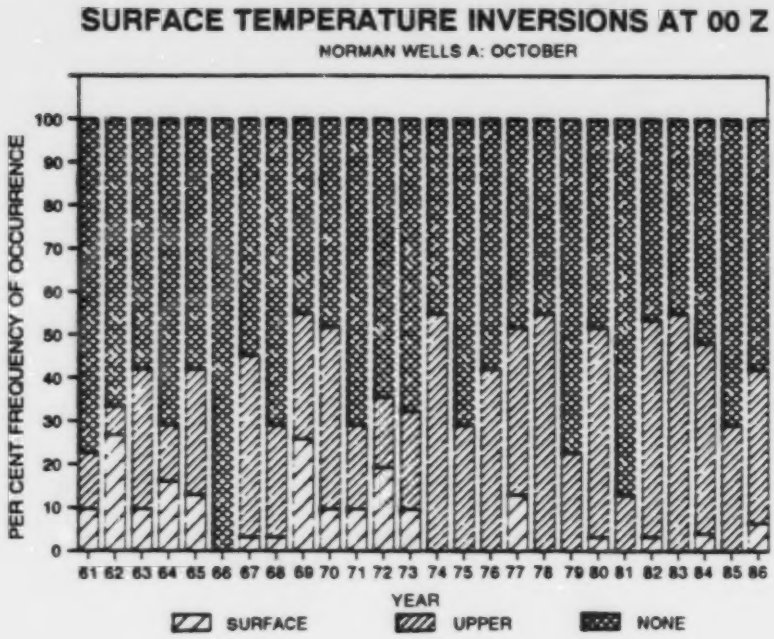

SURFACE TEMPERATURE INVERSIONS AT 00 Z
NORMAN WELLS A: OCTOBER
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
SURFACE
UPPER
NONE

Figure 3.24a: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 0 Z in October.

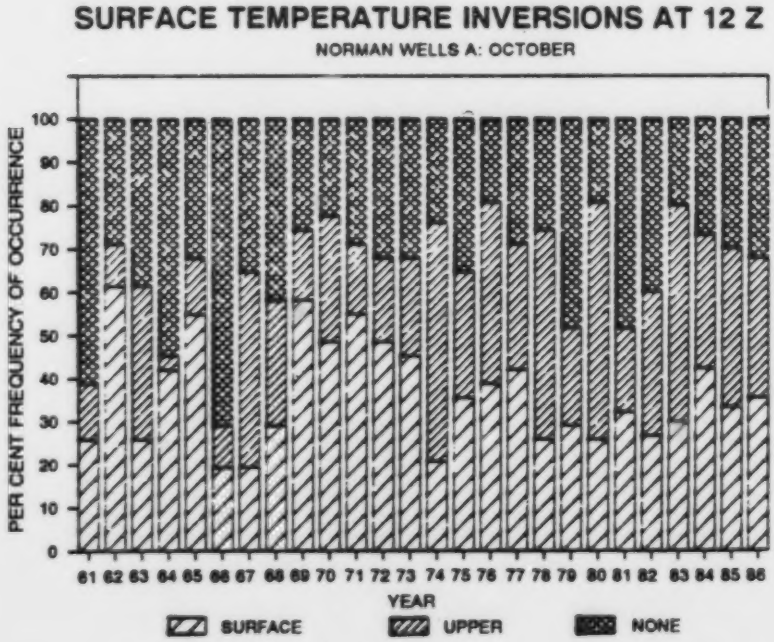

SURFACE TEMPERATURE INVERSIONS AT 12 Z
NORMAN WELLS A: OCTOBER
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
SURFACE
UPPER
NONE

Figure 3.24b: The time series of monthly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 12 Z in October.

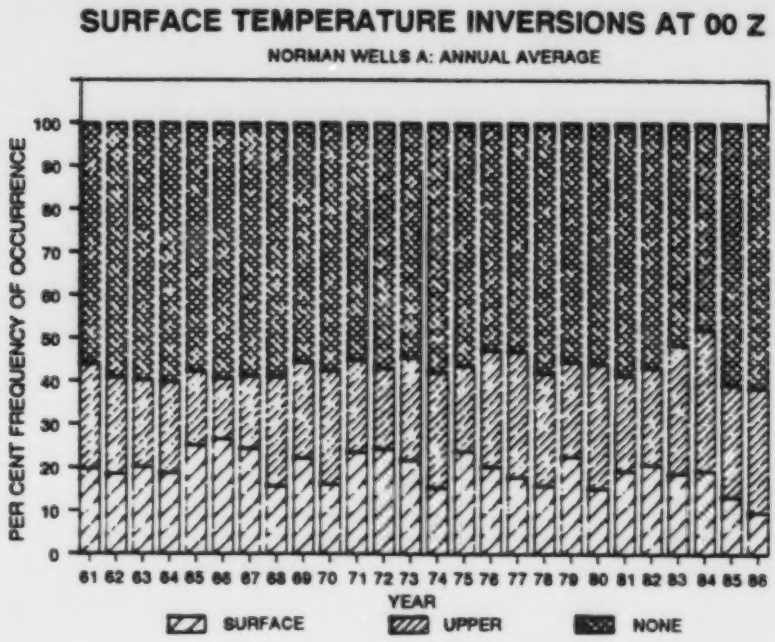

SURFACE TEMPERATURE INVERSIONS AT 00 Z
NORMAN WELLS A: ANNUAL AVERAGE
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
SURFACE
UPPER
NONE

Figure 3.25a: The time series of yearly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 0 Z.

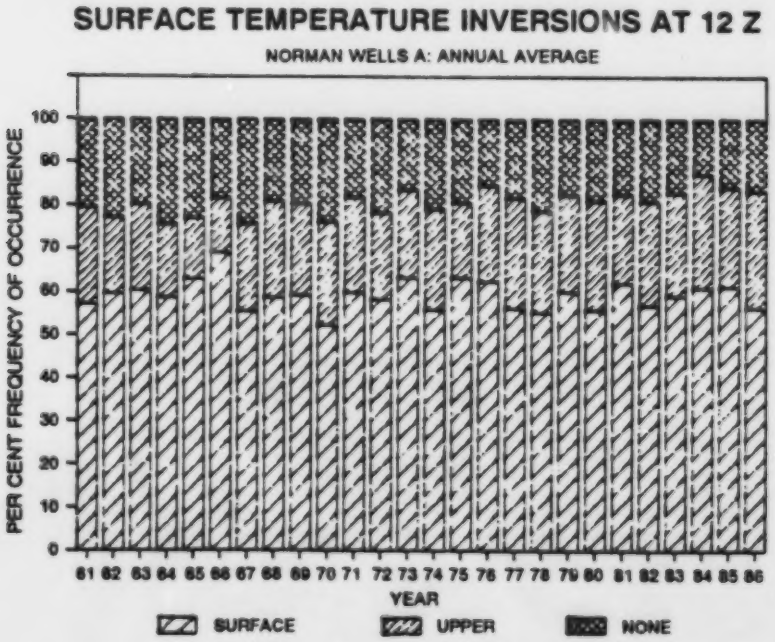

SURFACE TEMPERATURE INVERSIONS AT 12 Z
NORMAN WELLS A: ANNUAL AVERAGE
PER CENT FREQUENCY OF OCCURRENCE
0 10 20 30 40 50 60 70 80 90 100
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
SURFACE
UPPER
NONE

Figure 3.25b: The time series of yearly per cent frequency of occurrence of surface and upper level inversions is shown for Norman Wells A at 12 Z.

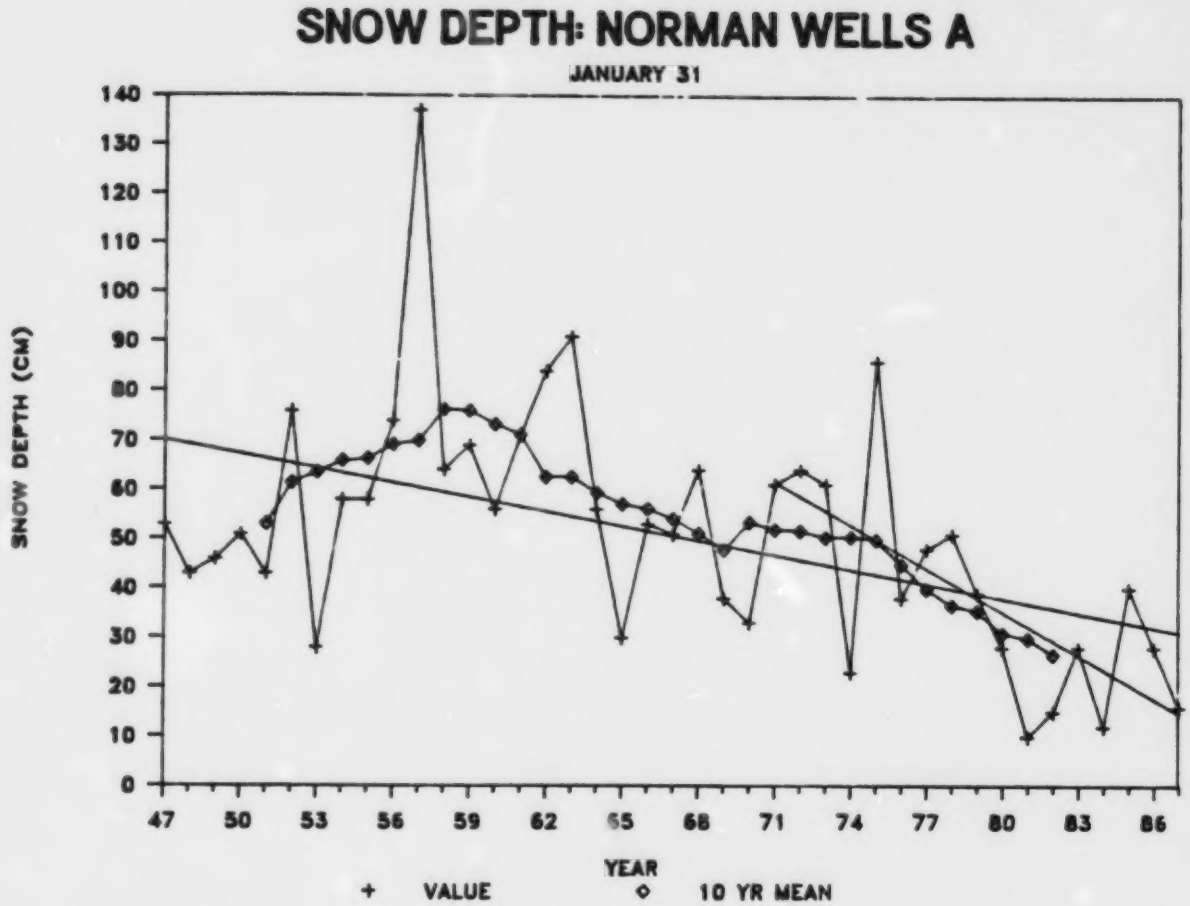


Figure 3.26: Mean monthly snow depth time series for Norman Wells A on January 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

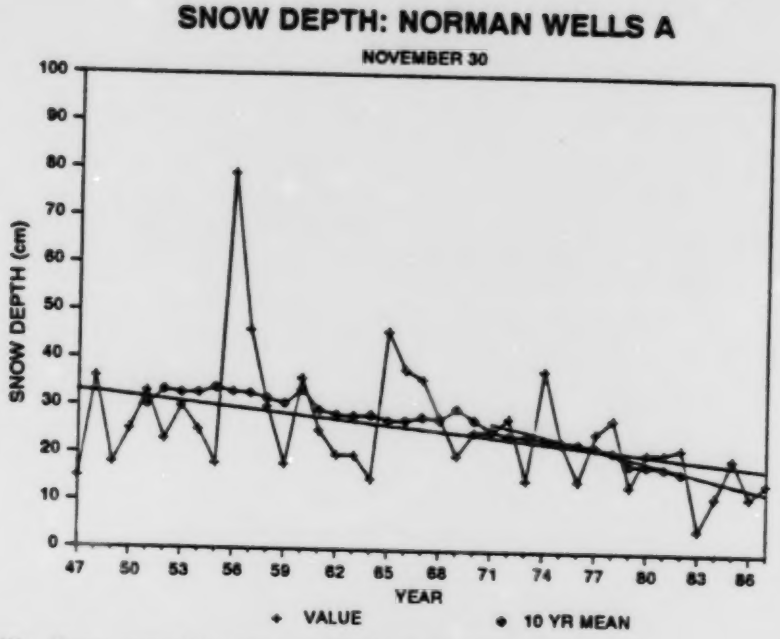


Figure 3.27: Mean monthly snow depth time series for Norman Wells A on November 30. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

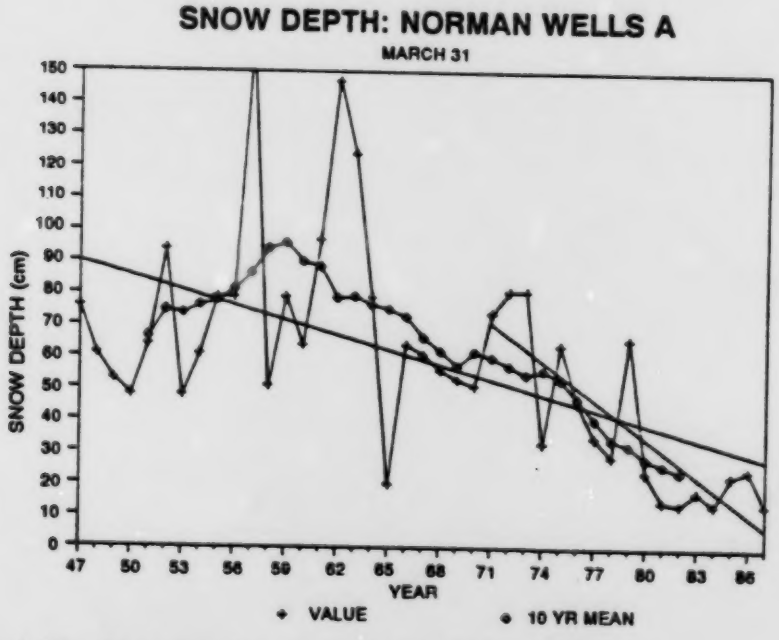


Figure 3.28: Mean monthly snow depth time series for Norman Wells A on March 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

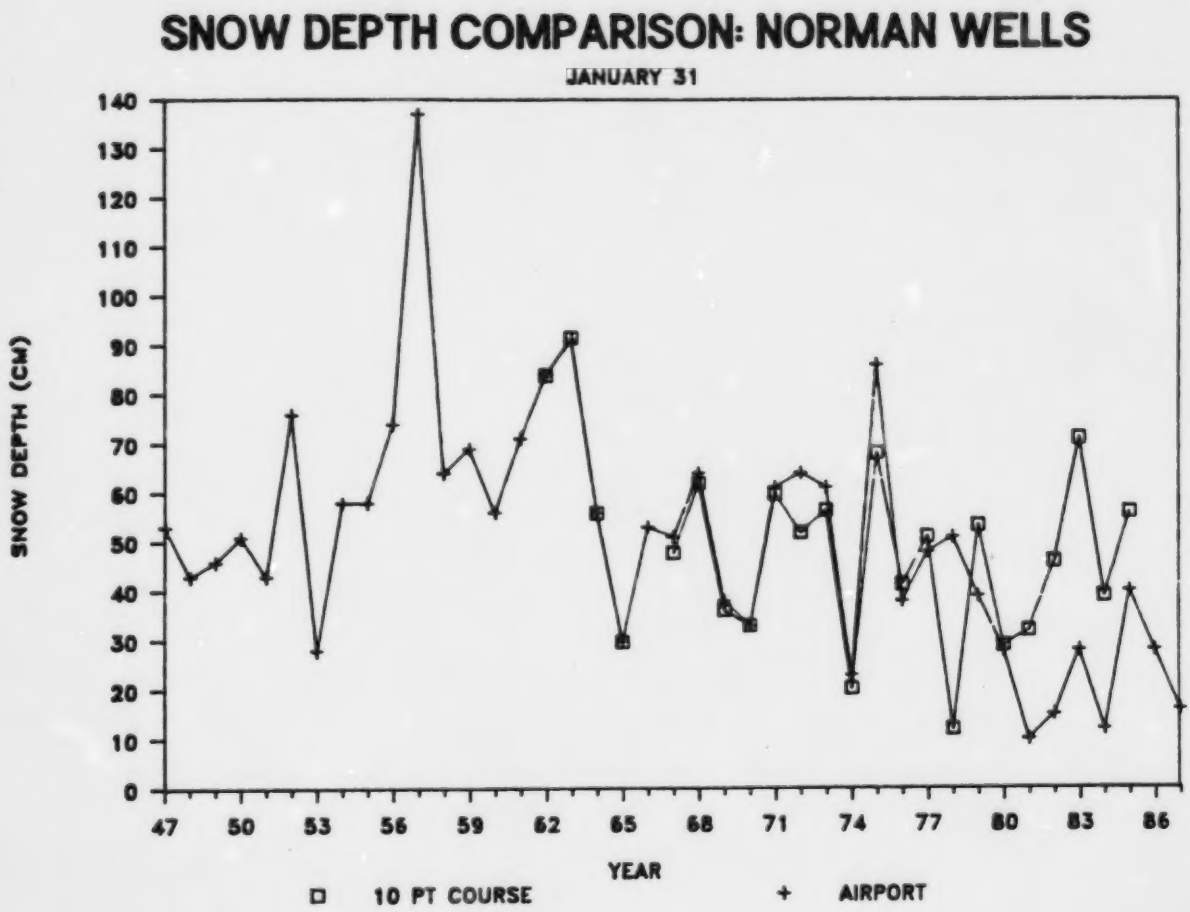


Figure 3.29: Mean monthly snow depth time series for Norman Wells A on January 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

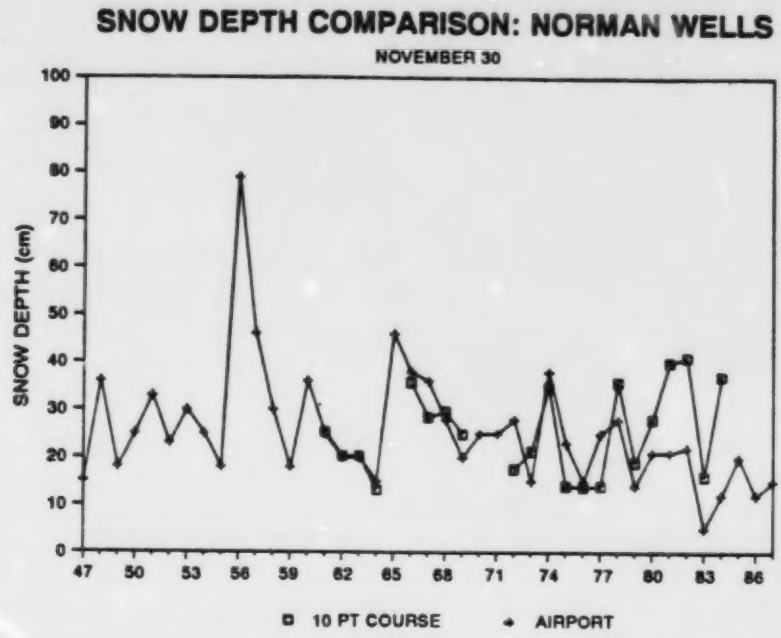


Figure 3.30: Mean monthly snow depth time series for Norman Wells A on November 30 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

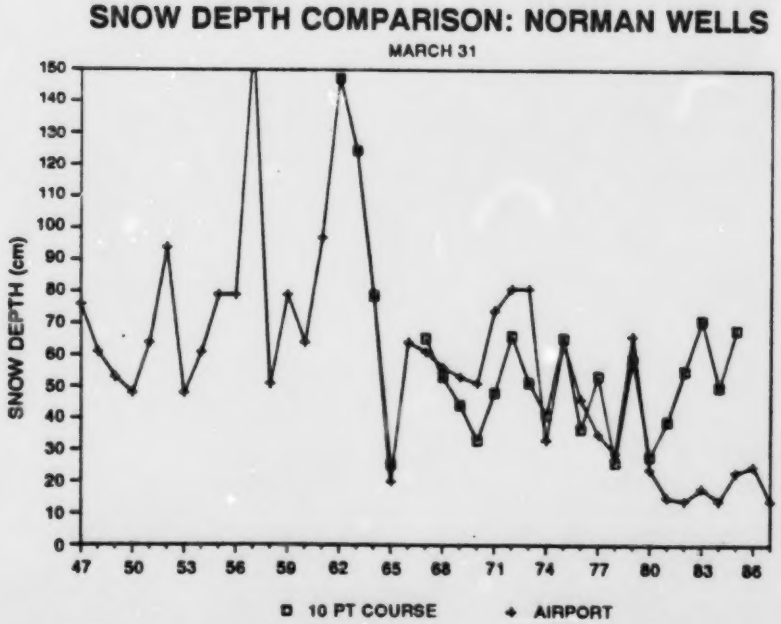


Figure 3.31: Mean monthly snow depth time series for Norman Wells A on March 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

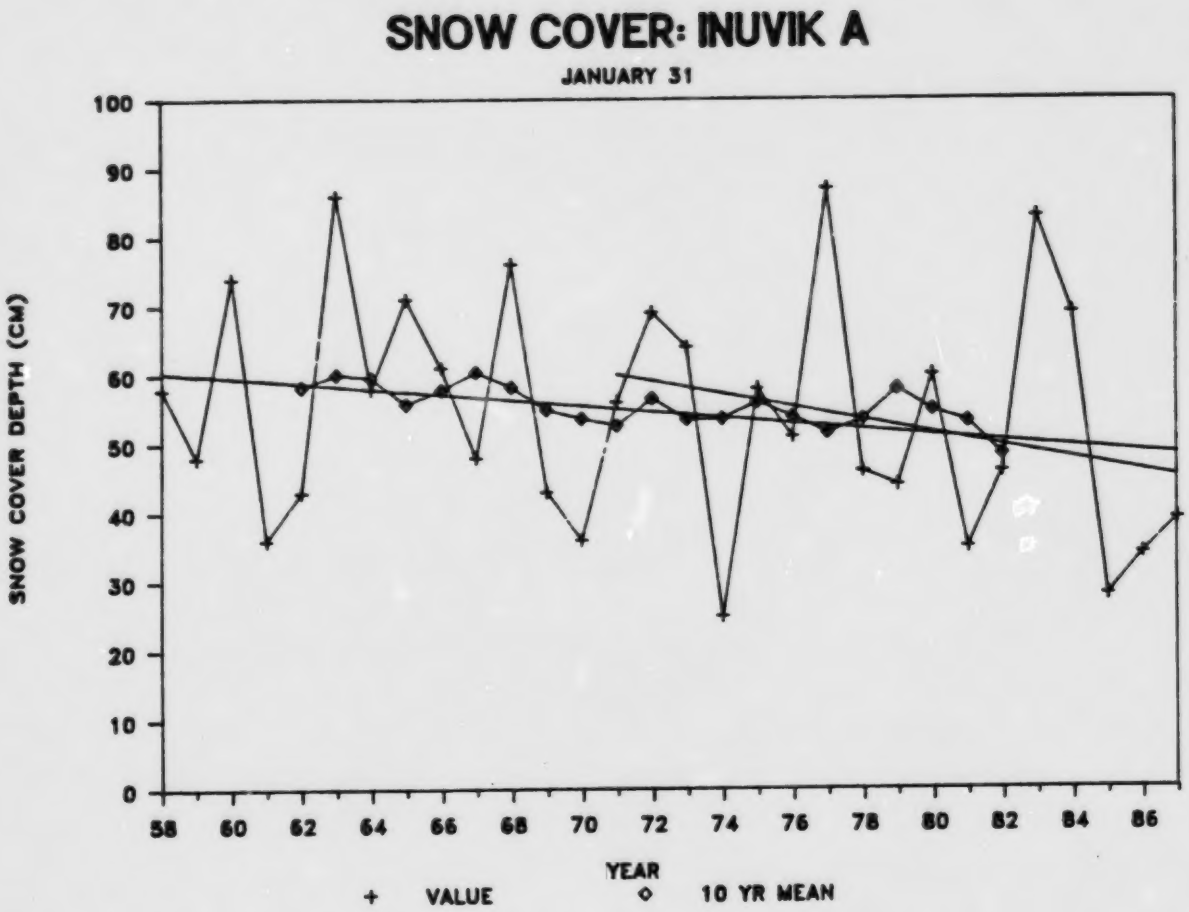


Figure 3.32: Mean monthly snow depth time series for Inuvik A on January 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

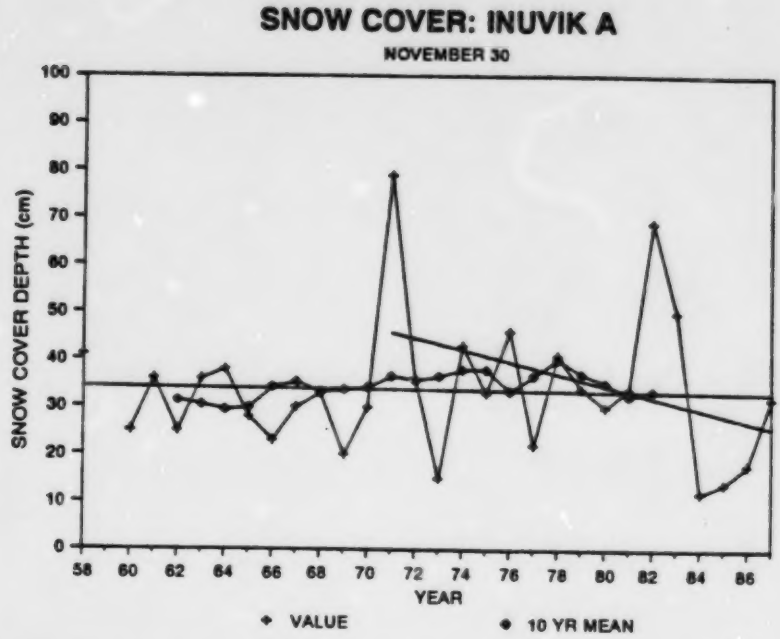


Figure 3.33: Mean monthly snow depth time series for Inuvik A on November 30. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

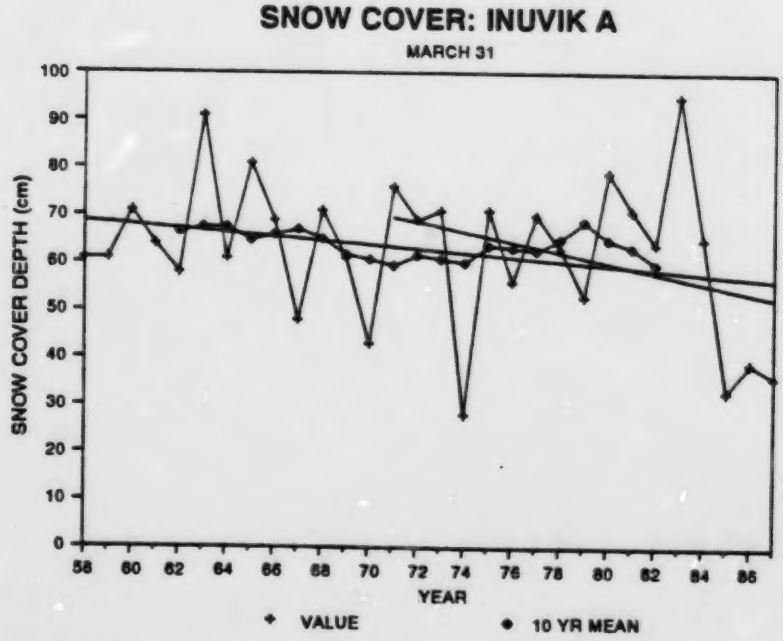


Figure 3.34: Mean monthly snow depth time series for Inuvik A on March 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

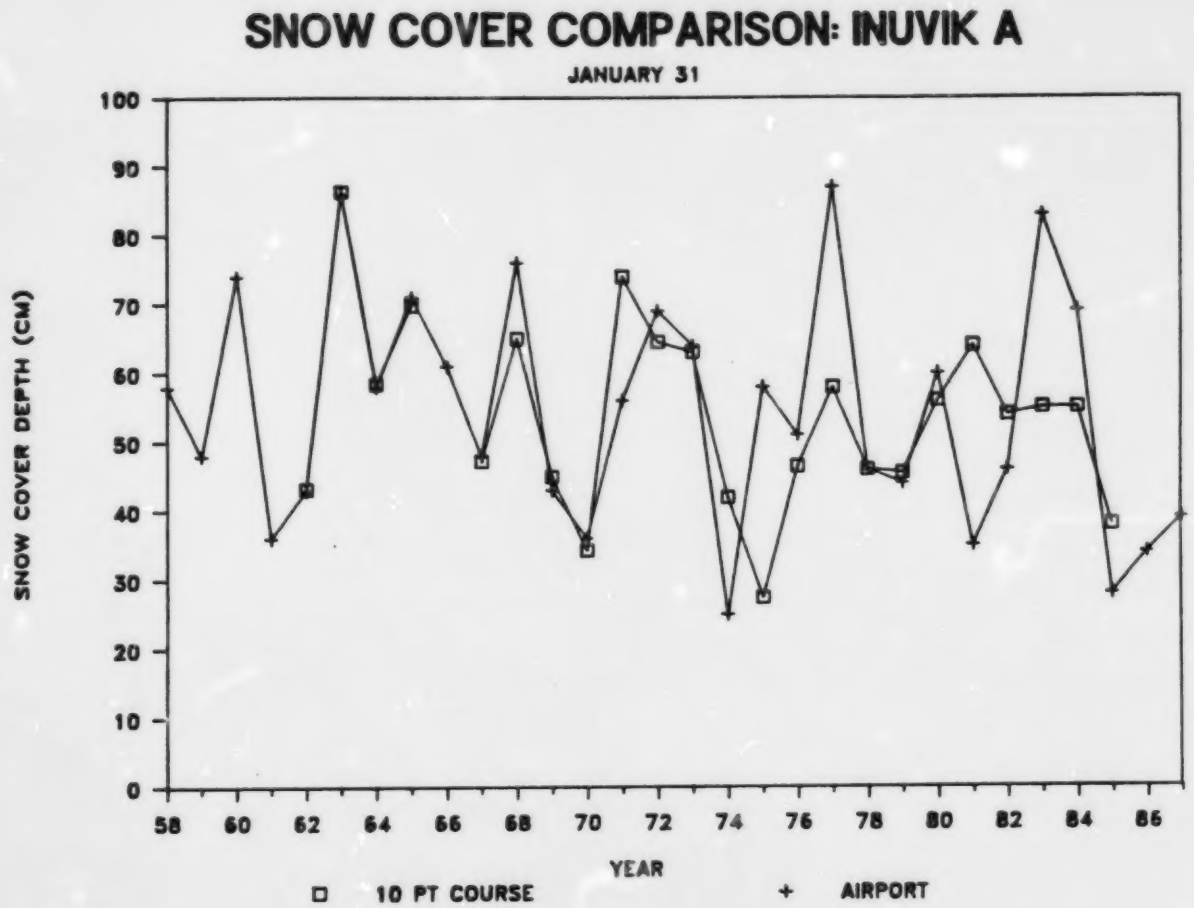


Figure 3.35: Mean monthly snow depth time series for Inuvik A on January 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

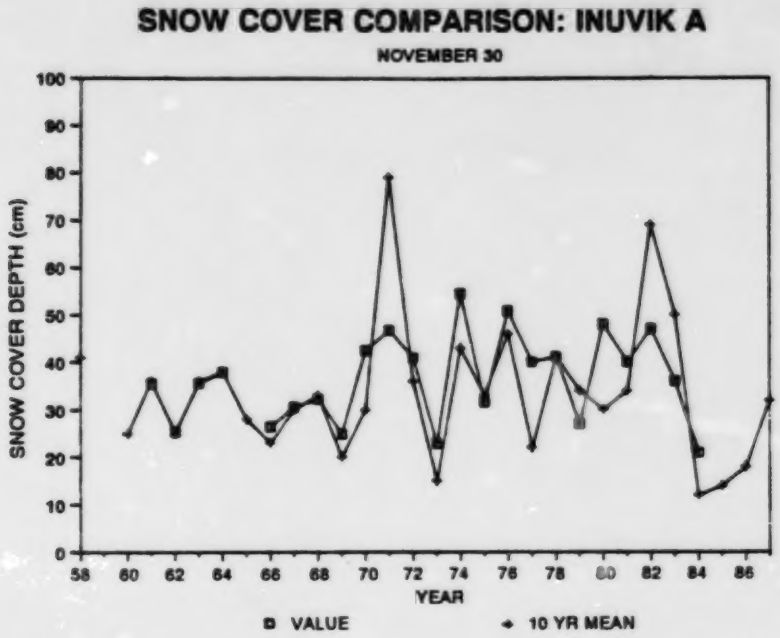


Figure 3.36: Mean monthly snow depth time series for Inuvik A on November 30 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

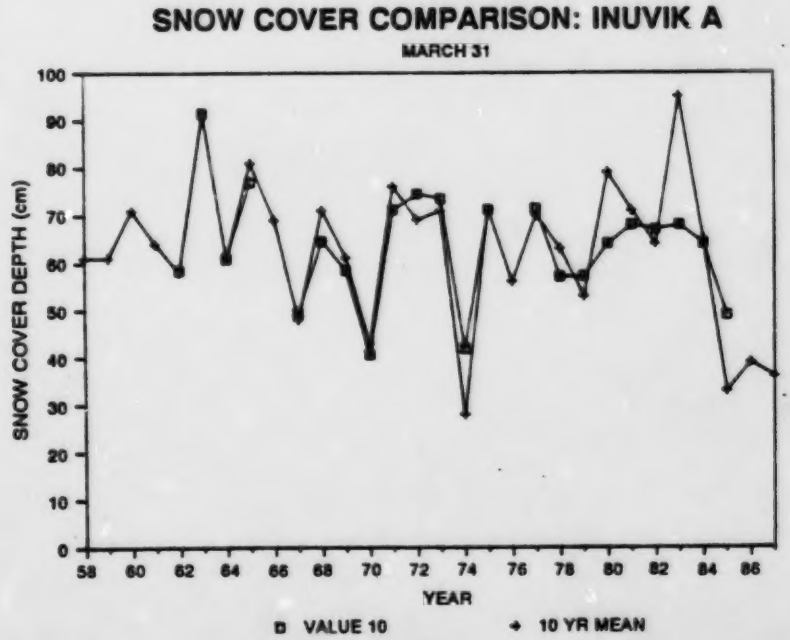


Figure 3.37: Mean monthly snow depth time series for Inuvik A on March 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

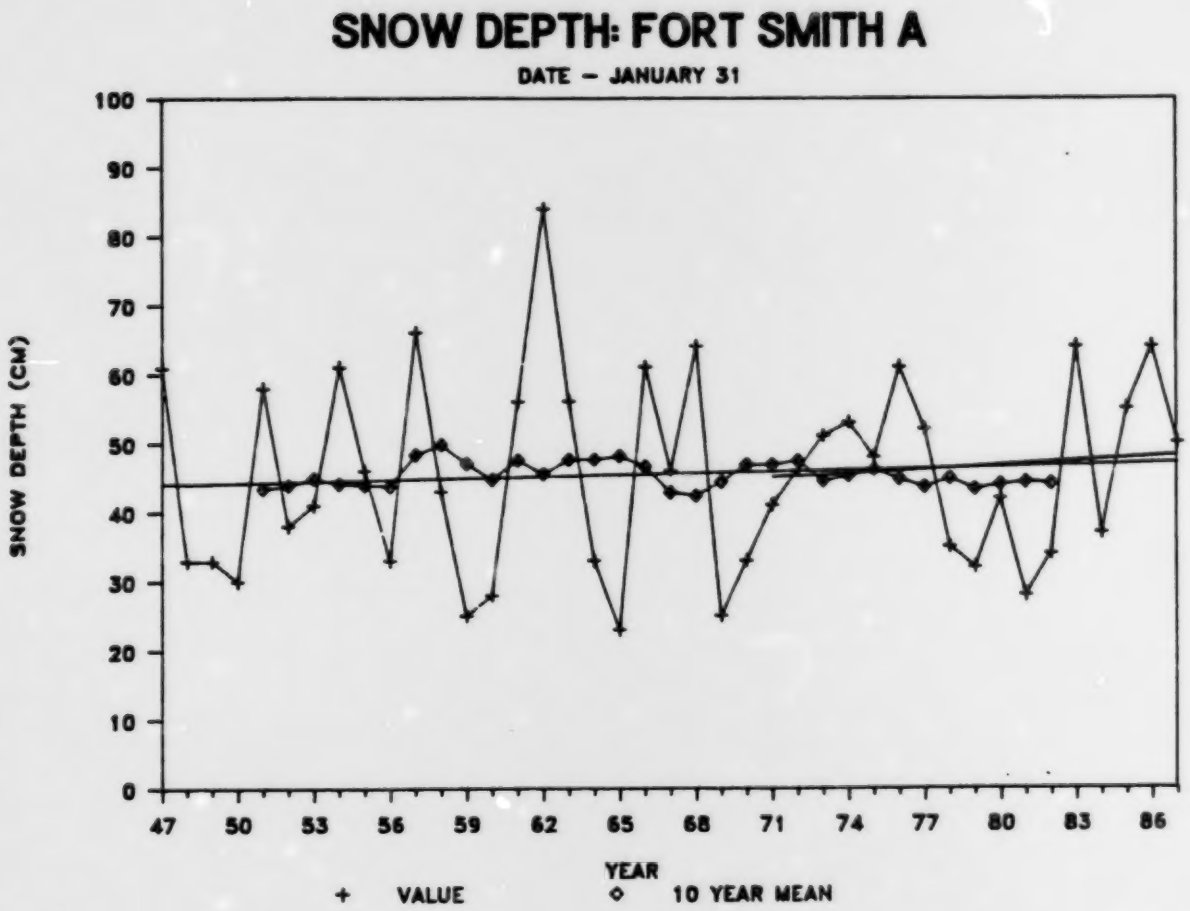


Figure 3.38: Mean monthly snow depth time series for Fort Smith A on January 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

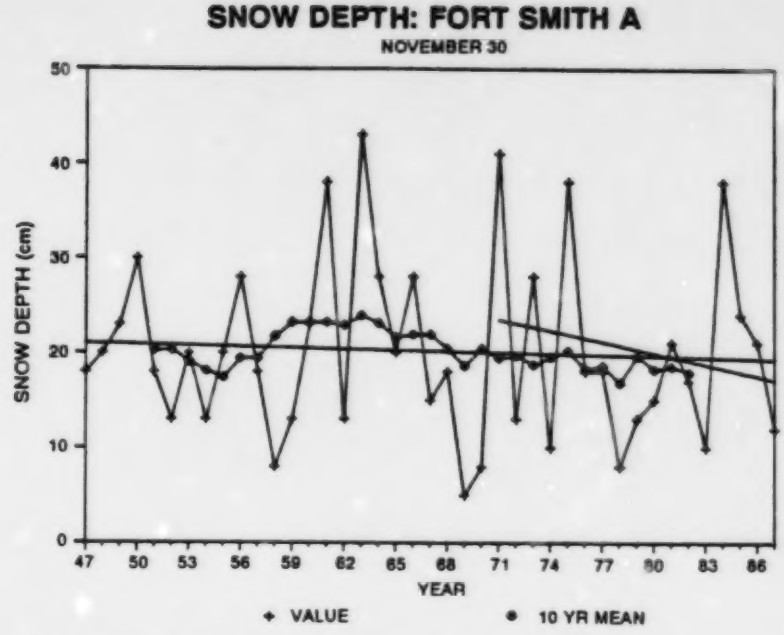


Figure 3.39: Mean monthly snow depth time series for Fort Smith A on November 30. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

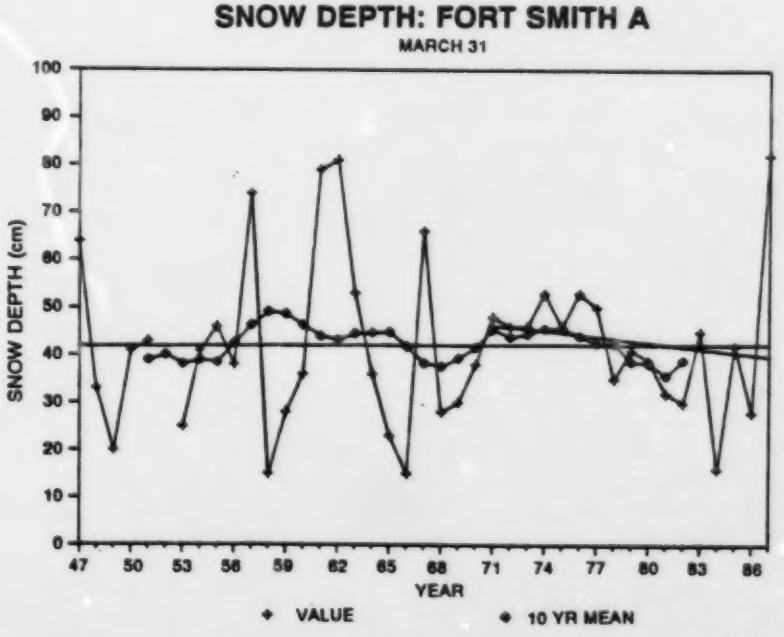


Figure 3.40: Mean monthly snow depth time series for Fort Smith A on March 31. Also shown are the time series of 10 year running mean values and the best-fit straight lines for the entire period of record and for the post-1970 period.

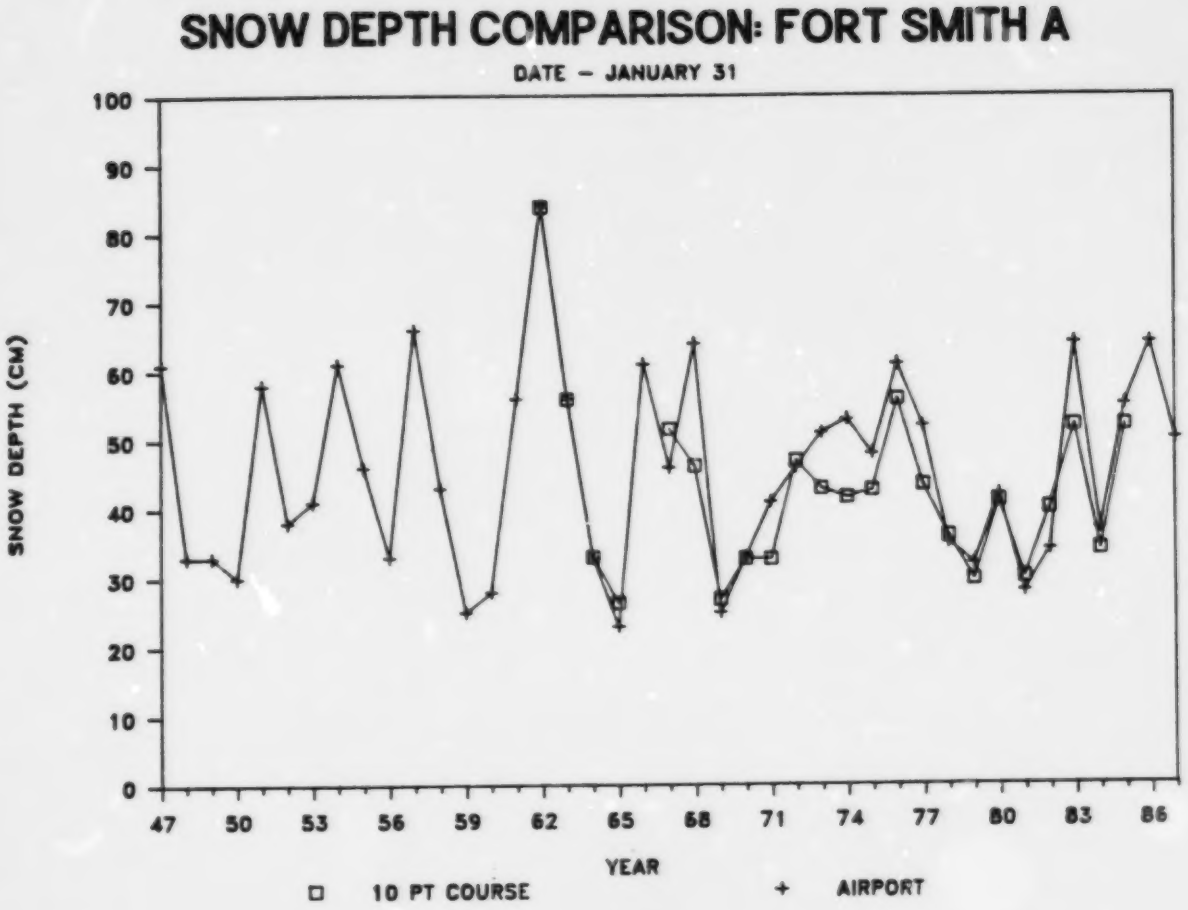


Figure 3.41: Mean monthly snow depth time series for Fort Smith A on January 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

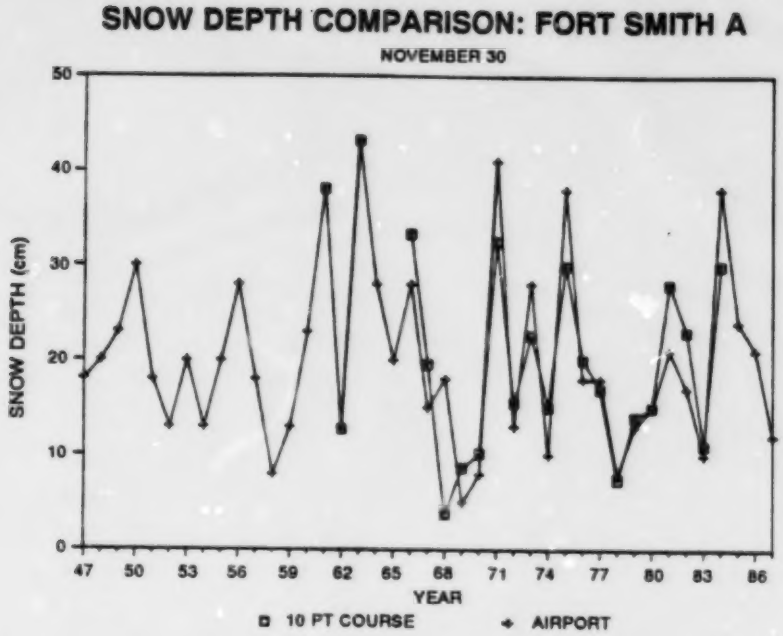


Figure 3.42: Mean monthly snow depth time series for Fort Smith A on November 30 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

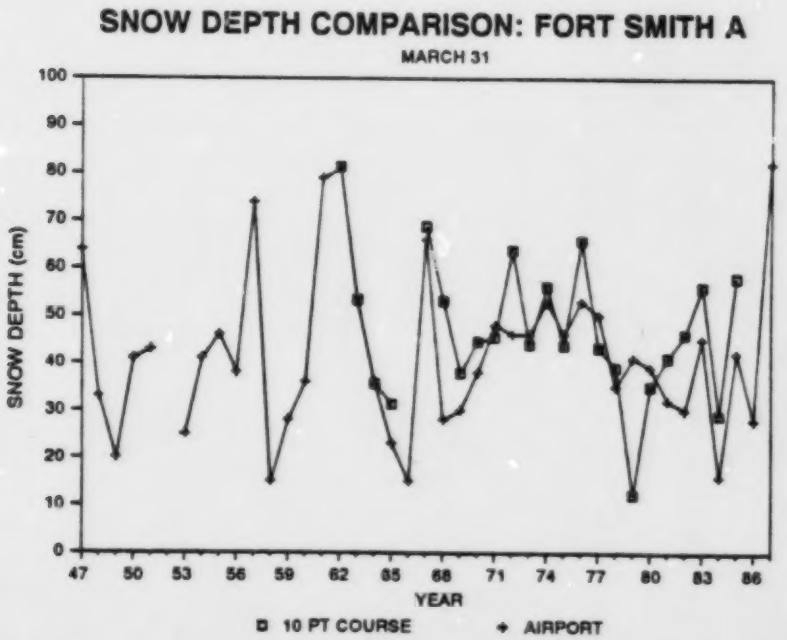


Figure 3.43: Mean monthly snow depth time series for Fort Smith A on March 31 is compared with snow depth measurements taken at the same time at a nearby 10 point snow course.

4. THE APPLICATION OF MACKENZIE VALLEY CLIMATE DATA TO THE FROST INDEX MODEL

4.1 A REVIEW OF THE FROST INDEX MODEL

The Frost Index model used in this study was developed by Stuart (1986) in an effort to gauge the impact of climate changes projected by General Circulation Models on permafrost regimes in the Canada. Based on monthly temperature and snow depths, the frost index was calculated for all AES climate stations in Canada that had an average annual temperature of 0 degrees or less, and for which it was possible to specify or estimate snow depths.

The frost index F was given by the following equation:

$$F = \sqrt{(FDD/TDD)}\ \exp(Z_s/Z_s^*) \qquad (4.1)$$

where FDD and TDD are the annual freezing and thawing degree days respectively, Z_s is the mean winter snow depth and Z_s^* is the mean winter thermal damping length of the snow cover.

In his previous studies Stuart determined that while the direct application of freezing and thawing degree days to the calculation of the frost index was the best method to include temperature effects, statistics on degree days were not always available. Mean monthly temperatures were always available for stations with temperature observations, however, and a method was sought to use these data when mean annual degree days were not available. It was found that the ratio of freezing and thawing degree days could be very accurately estimated by fitting the 12 mean monthly temperature values to a sinusoidal curve and then obtaining the ratio of the area enclosed by the curve below 0 °C to the area above 0°C . So long as the FDD/TDD value was less than 4 this approximation worked very well. For this report, freezing and thawing degree day information was not available in the data base selected, and this approximation was used.

Accurately including the effects of snow cover on the frost index proved to be much more difficult than including the effects of temperature. Direct snow depth measurements were not always available, particularly at observing stations in isolated areas run by volunteers. Even at locations where snow depth was measured, there were questions concerning both the accuracy of the measurement and its applicability even a few km from the measuring location. In the previous chapter, a comparison of airport snow depth measurements in the Mackenzie Valley and those from nearby snow courses showed that large differences have existed in recent years even when observing stations are less than 1 km apart.

While snow depth observations are sparse and often unreliable, most weather stations do provide daily precipitation amounts. These amounts are given in terms of depth of equivalent water, and are obtained by

melting the fallen snow. Using these data to estimate marginal increases in snow depth throughout the winter requires that an estimate of snow density be made, but this factor is almost always unavailable. While Stuart developed a method to estimate increasing snow depth from monthly precipitation totals, this report only uses observing stations for which direct measurements of snow depth exist.

The second factor that is necessary to estimate the effects of snow depth is the thermal damping length of snow, Z_s^*. This factor is a measure of the attenuation of temperature with increasing depth of the snow, and is dependent on the thermal properties of the snow layer. Any estimate of Z_s^* requires a second temperature measurement within or below the snow layer as well as a simultaneous measurement of air temperature. Such soil temperature measurements are not generally available with weather observations. In the previous work Stuart used average monthly snow depths measured at agricultural stations and the associated near surface soil temperatures in an attempt to obtain a suitable value of the thermal damping length of snow. The procedure was hampered by considerable scatter in the data. Only three stations were found to provide useful data and none of these stations was located in the Mackenzie Valley. Since this study is mainly concerned with climate change over time, any reasonable estimate of Z_s^* applied uniformly to all time-series should provide useful results. Nevertheless, it was considered appropriate that these estimates of thermal damping length be compared with new values derived herein from soil temperature data in the Canyon Creek area.

In the following section the frost index model previously developed by Stuart (1986) is combined with air temperature and snow depth time-series described in the previous chapter to obtain time-series of frost index values for stations in the Mackenzie Valley. Section 4.3 describes the application of Canyon Creek soil temperature data to obtain a new estimate of Z_s^*, and Section 4.4 concludes this chapter.

4.2 FROST INDEX TIME-SERIES FOR THE MACKENZIE VALLEY

Results for the regression analyses of time-series of frost index for all stations in the study area are given in Appendix 6. For frost index to be calculated for any given year, all 12 months of mean temperature data must be present in the data base and all winter month snow depths must also be present. This combined requirement reduces the number of data points in frost index time series, but in most cases these reductions are not severe enough to cause stations to be dropped. In the mid-valley area, however, only the Norman Wells A station has sufficient frost index values to permit an analysis to be carried out. In keeping with the format of the previous chapter, this area is discussed first.

4.2.1 The Mid-Valley Region

In the Chapter 3 analysis of the Norman Wells Airport observing station, warming trends were detected in winter and summer and for the mean annual temperature, while snow cover has apparently decreased over the past several years. These trends will tend to counteract one another in their net effect on permafrost; higher temperatures will destabilize permafrost layers while thinner snow layers will permit more of the effects of the cold winter temperatures to penetrate into the soil.

The effects of air temperature on the frost index are shown in Figure 4.1. In this figure, the "temperature only" time-series has been obtained by ignoring all snow effects. The 10 year running mean value of the frost index is also given as are the best-fit regression lines over the entire period of record and for the post-1970 period. Also included in this Figure is the "temperature and average snow" curve which includes the variations in year-to-year temperature effects and assumes snow depth and snow layer thermal damping lengths equal to their respective mean values over the entire period of record. This curve will closely resemble the other time-series in the Figure since they differ only by constant factor which is equal to the average effect of snow cover on the frost index. For Norman Wells A, a gradual decline in the frost index is noted over the entire period of record, and the confidence associated with this decline is greater than 99 per cent. For the post-1970 period, however, the high variability of frost index values and the reduced rate of decrease combine to lower the confidence associated with this trend below 90 per cent.

The examination of snow cover at Norman Wells A (Section 3.4.1) showed a dramatic decrease in snow depth, which will tend to increase the frost index and the stability of permafrost layers. As is evident in Figure 4.2, the effects of decreased snow cover are sufficient to reverse the warming due to increased temperatures. These increases, both over the entire period of record and during the post-1970 period, are both associated with confidence levels exceeding 99 per cent. The impact of the increases may be best appreciated through a geographic comparison. Using the entire period of record regression analysis, for example, the estimated frost index at Norman Wells in 1940 would be approximately equal to the long term climate norm at Fort Smith. By 1970, the Norman Wells estimate is close to its own long term average, and by 1990, conditions will apparently resemble the long term norm at Aklavik. The best fit regression line for Norman Wells, then, produces the same breadth of frost index values as are observed over the entire extent of the Mackenzie Valley. The steeper, post-1970 regression line suggests that in 20 years conditions in Norman Wells will vary from climatic norms at Yellowknife in 1970 to Inuvik in 1990. It should be emphasized that this extrapolation in time is given for illustrative purposes only, and it is not suggested that these curves have any predictive value.

The significance of the Norman Wells snow course data becomes very high given these results of frost index trends. These data (Figures 3.29 - 3.31) show that the Norman Wells Airport observations after 1980 are very likely unrepresentative of the area and that the post-1970 period has had no significant decrease in the snow depth. If this is true then the frost index might well have decreased in the post-1970 period - which is opposite to the conclusions using the Airport data.

The other stations in the mid-valley area - Fort Good Hope, Wrigley A and Tungsten - have too many data gaps to permit an adequate time-series of frost index to be developed.

In summary, the effect of recent climate change on permafrost as simulated in the frost index model in the Norman Wells area is unclear at the present time because of apparent problems in the measurement of snow depth at the Norman Wells Airport. Temperatures certainly seem to have risen in winter and in summer, and this indicates with high confidence a decreasing frost index. In contrast to these results, snow depths as measured at the Norman Wells Airport have fallen so much that this effect is completely reversed - again with a high degree of confidence. Independent snow depth observations at a nearby snow course cast considerable doubt on the representativeness of the airport observations, and until the snow course observations are applied to the frost index model we cannot be sure if the snow depths observed at the snow course are sufficient to reverse the temperature trend or not.

4.2.2 The Arctic Coast and the Mackenzie Delta Area

Frost index time-series for Inuvik A are shown in Figures 4.3 and 4.4. In figure 4.3, a moderate decrease in the frost index due to temperature effects only is noted for the entire period of record, but the associated confidence level is less than 90 per cent. For the post-1970 period, the trend is also negative and the confidence level is also very low. When both temperature and snow effects are considered (Figure 4.4) both the entire period of record and the post-1970 period indicate positive trends, again with low levels of confidence.

At Komakuk Beach, both temperature only and temperature and precipitation frost indices have confidence levels below 90 per cent for both the entire period of record and the post-1970 period. At Tuktoyaktuk, all four frost index trends are negative indicating a warming of soil layers over time. Moreover, the temperature and snow depth frost index over the entire period of record has an associated confidence level in excess of 90 per cent. At Shingle Point A, all trends are also down. The temperature and snow frost index trends over the entire period of record has a confidence level greater than 90 per cent, while decreasing values during the post-1970 period have a confidence level greater than 95 per cent.

At two of the four northern stations, then, the frost index time-series indicates a warming over the entire period of record and since 1970. For the other two stations the trends are not nearly as clear.

4.2.3 The Upper Mackenzie Valley and the Great Slave Lake Area

Frost index time-series for Fort Smith A are shown in Figures 4.5 and 4.6. Obvious declines in frost index values are observed in both figures; over the entire period of record, confidence levels associated with both the temperature only and the full frost index are greater than 99 per cent. For the post-1970 period, however, the level of confidence is lower for both the temperature-only index (95 per cent) and the temperature and snow depth index (90 per cent). In geographic terms the regression line over the entire period of record would suggest that in 1940 conditions in Fort Smith resembled the climate norms at Yellowknife; by 1970, the estimated frost index is close to the long term value at Fort Smith, and by 1990, it will have decreased to approximate the long term norm at Fort Chipewyan. Again, it should be emphasized that extrapolations into the future have no predictive value, and are given here for illustrative purposes only.

For all six other observing stations in the upper Mackenzie area whenever the confidence level associated with a trend is greater than 90 per cent, the trend is invariably negative. In addition to Fort Smith A, high confidence levels are noted for temperature only frost indices over the entire period of record for Fort Simpson A, Hay River A and Yellowknife. With the exception of Fort Smith A, high confidence levels are never observed for the temperature-only frost index for the post-1970 period. Time-series of frost index with both temperature and snow effects have high confidence trends for the post-1970 period at Hay River A, and for the entire period of record at Fort Simpson A and Fort Smith A.

In summary, all high confidence trends near the mouth of the Mackenzie River and in the upper valley near Great Slave Lake indicate a warming of the permafrost layer over either the past 40 years or the past 20 years. Only in Norman Wells is this pattern broken. Very low snow depth measurements at the Norman Wells Airport in recent years are the cause of strong trends in the opposite direction at this station. These measurements are not corroborated by nearby snow course observations, and must be examined further.

4.3 NEW ESTIMATES OF THE THERMAL DAMPING LENGTH OF SNOW

Previous work by Mellor (1977) suggested that Z_s^* should vary with the square root of the snow density, which in turn could be estimated from air temperature and wind speed observations using a method developed by Bilello (1969). In the initial development of the frost index model (Stuart, 1986) nine of the 13 available stations with

monthly mean soil temperature data were unsuitable because of large uncertainties in the estimate of Z_s^* due to data scatter. Of the four remaining stations, three had very similar average snow density estimates and yet only two of these three stations showed agreement in their estimate of Z_s^* - thus contradicting Mellor. When the outlying station was rejected, and the average damping depth of the other two stations (Watson Lake, Yukon and Cree Lake, Saskatchewan) was obtained, three of the four original stations with useful data yielded only one estimate of Z_s^* (32 cm) and its corresponding snow density (.25 g/cm^3). The fourth station was Baker Lake, N.W.T., and from its data a second estimate of Z_s^* and its associated snow density (98.9 cm and .36 g/cm^3 respectively) was obtained. From these two points the following relationship was developed using Mellor's (1977) relationship:

$$Z_s^* = -301.3 + 667 \sqrt{D} \qquad (4.1)$$

where Z_s^* is in cm and D is the snow density in g cm^{-3}. This estimate is based on only two data points, which are in turn derived from monthly averages of air temperature, soil temperature and snow depth.

During the course of this study we were able to obtain daily measurements of air temperature, snow depth and 0.5 m soil temperatures made by the Atmospheric Environment Service and Geological Survey of Canada over the past two years at Canyon Creek, near Norman Wells in the Mackenzie Valley. Figure 4.7 shows a detailed time-series of air temperature, soil temperature and snow depth for the period October 13 - November 13, 1987 at Canyon Creek. For the first eight days of the period, snow depths are below 10 cm and air and soil temperatures are both below the freezing point of water; under such circumstances, air and soil temperatures track one another very closely. For the next four day period the mean daily air temperature rises above the freezing point; the soil temperature moves up to the freezing point but does not cross it - presumably because of the latent heat requirements to melt the snow layer and/or the ice in the soil. Shortly after the air temperature falls below the freezing point again the snow depth rapidly rises to a depth of 30 cm. During this period the correlation between air and soil temperatures deteriorates rapidly. With a snow layer in excess of 30 cm variations of up to 10°C in daily air temperature are accompanied by only 3-4°C changes in soil temperature. Air and soil temperatures are still connected, however, in that an increase or decrease in one is accompanied by a change of the same sign in the other. Once the snow depth becomes greater than 50 cm (Figure 4.8) only large sudden changes in air temperature affect the soil temperature value.

If we assume that the soil temperature, T_s, is equal to the temperature at the bottom of the snow layer, then the thermal damping length of the snow layer is given by the following equation:

$$T_s = T_a \exp(-Z_s/Z_s^*), \qquad (4.2)$$

or equivalently,

$$Z_s = Z_s^* \ln(T_a/T_s). \qquad (4.3)$$

where T_a is the air temperature above the snow layer and Z_s is the snow depth. If we now perform a linear regression with $\ln(T_a/T_s)$ as the independent variable and snow depth as the dependent variable, then according to Equation 4.3, the slope of the regression line should be equal to the thermal damping length. Furthermore, as an independent check of the accuracy of the procedure, the y- intercept of the regression should be close to zero. Clearly, since the argument of the logarithm cannot be negative, it is essential that both the air and soil temperatures be less than zero.

As was seen in Figures 4.7 and 4.8, for days with large snow depths, air and soil temperatures are very weakly correlated. Accordingly, we must expect a wide range of values of $\ln(T_a/T_s)$ for a given value of Z_s if Z_s is sufficiently large. This is equivalent to saying that large data scatter will accompany large values of Z_s, and that if we require an accurate estimate of Z_s^*, then we must only consider observations with Z_s below a certain given value. It was found that best results were obtained when only observations satisfying the following criteria were included in the regression analysis:

$$T_a < 5 \text{ C}$$
$$T_s < 0 \text{ C}$$
$$Z_s < 50 \text{ cm}$$

This value for Z_s is the same as that noted by Harris (1981, 1983) as the maximum value for the existence of permafrost.

Following these restrictions, the regression analysis scattergram for the Canyon Creek data set is shown in Figure 4.9. The intercept of the best-fit straight line is very close to zero which lends considerable weight to the results. The slope of this curve is 46.6 cm, and the associated standard error of estimate is 5.4 cm.

Mellor (1979) has shown that Z_s^* should vary as the square root of the average snow density of the layer. To test this hypothesis, Equation 4.3 is rewritten as follows:

$$Z_s = [Z_s^*/\sqrt{D}]\ [\sqrt{D}\ \ln(T_a/T_s)], \qquad (4.4)$$

where the independent variable is now $\sqrt{D}\ \ln(T_a/T_s)$, and the slope of the regression is the proportionality constant between the thermal damping length of the square root of the snow density.

The scattergram of this regression analysis is shown in Figure 4.10. In this graph a second regresssion line is also drawn. This represents the best linear fit to the data assuming that the y-intercept is exactly zero. As may be seen, there is very little difference between the two lines since again the intercept of the first

line is very close to zero. The slope of this curve is estimated to be 87.3 $cm^{2.5}$ $g^{-0.5}$, and the standard error of estimate is 8.6 $cm^{2.5}$ $g^{-0.5}$.

Since the standard error of estimate of the slope for each of the preceding regression analyses is approximately 10 per cent of the slope itself, the inclusion of snow density does not greatly affect the accuracy of the results. Accordingly, we will include a consideration of snow density in the estimation of Z_s^*.

A comparison of this estimate of Z_s^* with that used in Stuart (1986) is shown in Figure 4.11. Also shown in this figure are the average snow densities for several stations in the Mackenzie Valley as estimated by Bilello (1969). The two methods produce very similar estimates for Z_s^* for most stations in the Mackenzie Valley and differ significantly only for stations in the far north and south of the study area.

This degree of agreement is also evident in comparisons of frost index calculations using the two methods to estimate the thermal damping length of snow. Figure 4.12 demonstrates that for Norman Wells, frost indices calculated by the the two procedures are virtually identical. Certainly, the conclusions with respect to trends and time-series regression analyses for Norman Wells would not change with the improved estimate of Z_s^*.

Figures 4.13 and 4.14 show similar comparisons of frost index calculations for High Level A and Tuktoyaktuk respectively. Since these stations have the largest differences in the estimate of Z_s^*, it is not unexpected to observe large differences in the frost index estimate in these figures. These differences are quite consistent from year-to-year, though, with the result that our conclusions regarding trends and their associated significance levels are not changed by the new method of estimating Z_s^* - even for these stations which have the greatest variation in frost index. We may conclude that the improved estimate of Z_s^* will have no impact on our conclusions regarding frost index trends.

4.4 CONCLUSIONS

The application of the frost index model developed by Stuart (1986) to air temperature and snow depth data obtained from stations in the Mackenzie Valley has been carried out. Fluctuations in these parameter values have resulted in changes in the frost index, which is a measure of the stability of the permafrost layers in the area around the observing site. In all cases except one where these fluctuations produced definite trends, these trends are to warmer conditions and a reduction in the stability of the permafrost layer. The exception is an important one since it applies to Norman Wells, and indicates with a high degree of confidence that the stability of the permafrost layer has actually increased in this area of the Mackenzie Valley. A closer examination of the Norman Wells results showed that very low snow depth observations in the 1980's were responsible for these conclusions which were exactly opposite to all others in the study. These observations

are in sharp disagreement with simultaneous measurements made at a nearby snow course. It is quite possible that the presumably more accurate snow course observations would result in different conclusions for the Norman Wells station.

The thermal damping length of the snow layer is one of the most difficult parameters to estimate accurately in the frost index model. In this study new observations at Canyon Creek in the Norman Wells area were used to develop a new estimate for this parameter. When a comparison of the new estimate and that developed by Stuart (1986) was made, it was found that very little difference existed in the two estimates for most stations in the Mackenzie Valley. However, these differences grew for stations on the Arctic coast and for stations in northern Alberta, suggesting that the parameterization had very limited geographical applicability.

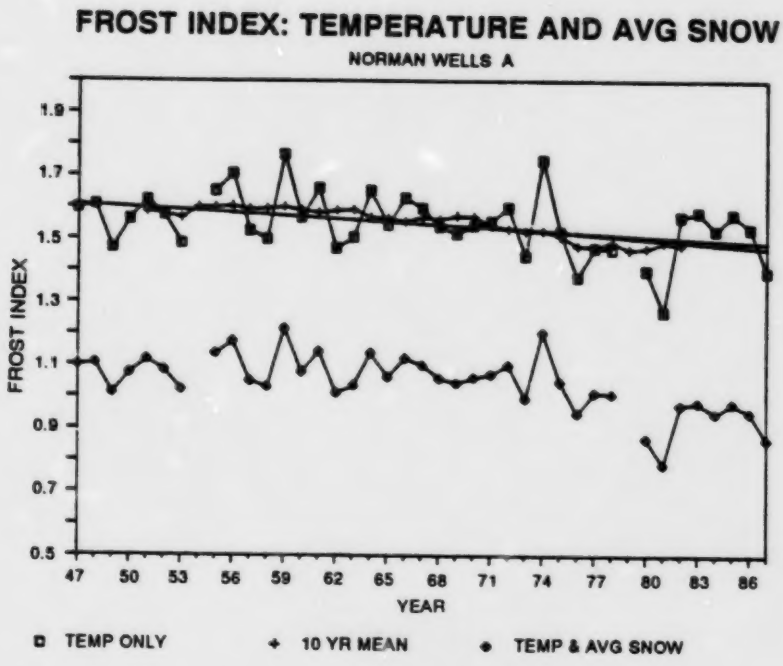


Figure 4.1: For Norman Wells A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period. Also shown is the time series of frost index values assuming that the effect of snow is its average value over the entire period of record ("TEMP AND AVG SNOW").

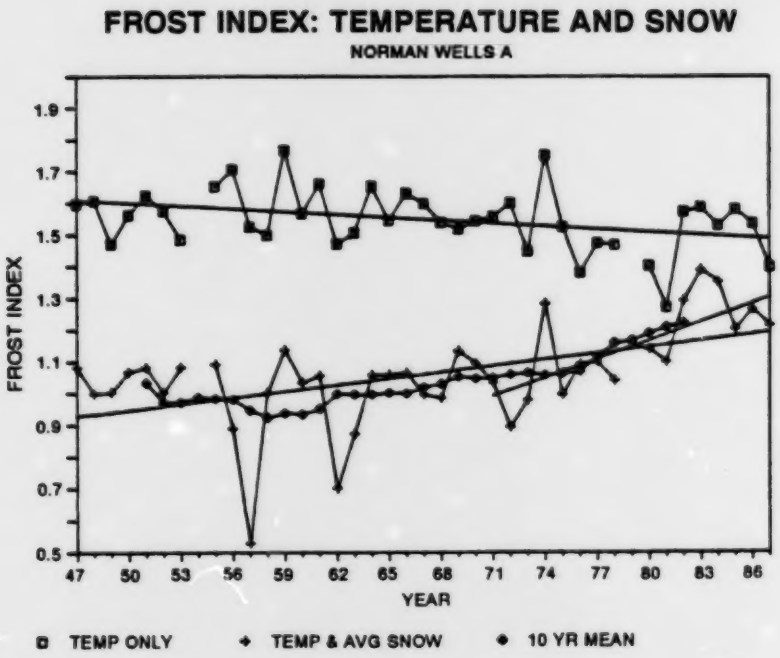


Figure 4.2: For Norman Wells A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the best-fit straight line over the entire period of record as in the previous Figure. Also shown is the time series of frost index values assuming actual temperature and snow depth observations ("TEMP AND SNOW") along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period.

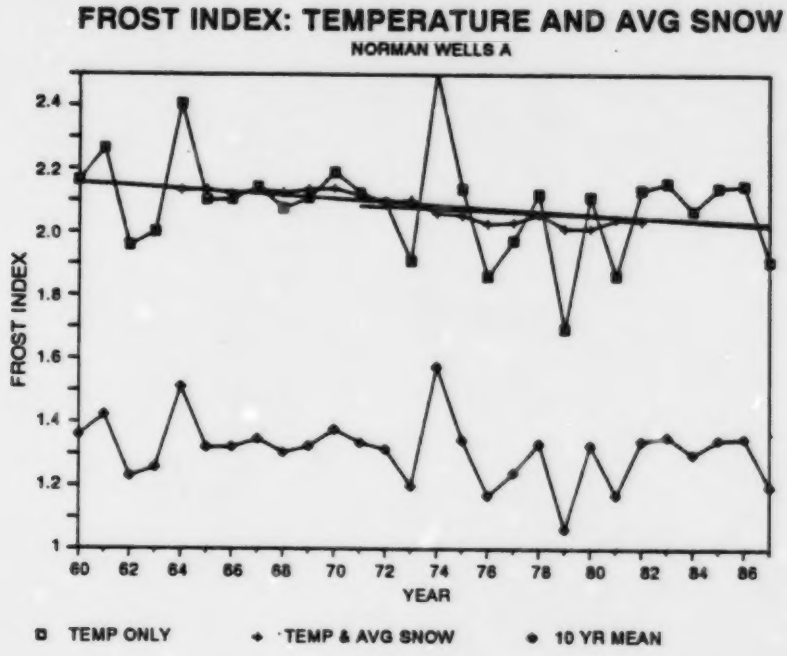


Figure 4.3: For Inuvik A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period. Also shown is the time series of frost index values assuming that the effect of snow is its average value over the entire period of record ("TEMP AND AVG SNOW").

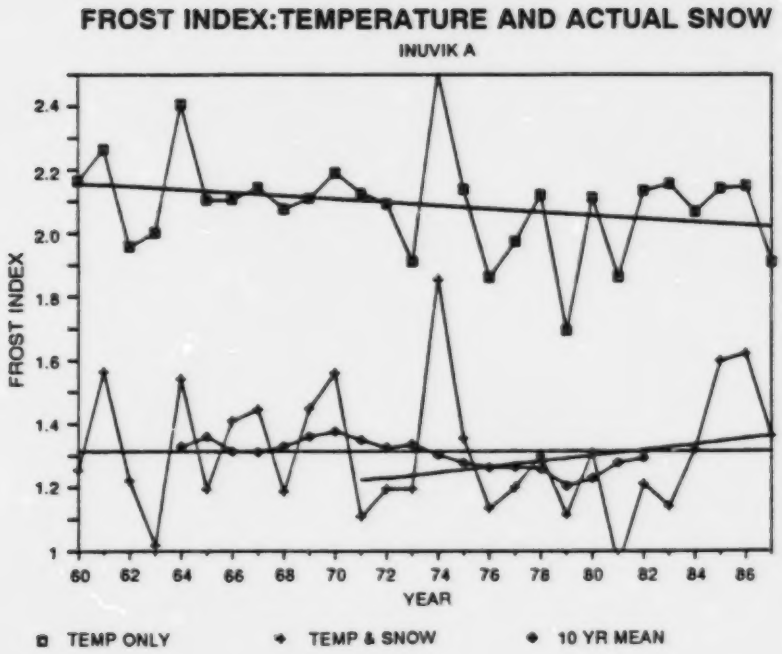


Figure 4.4: For Inuvik A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the best-fit straight line over the entire period of record as in the previous Figure. Also shown is the time series of frost index values assuming actual temperature and snow depth observations ("TEMP AND SNOW") along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period.

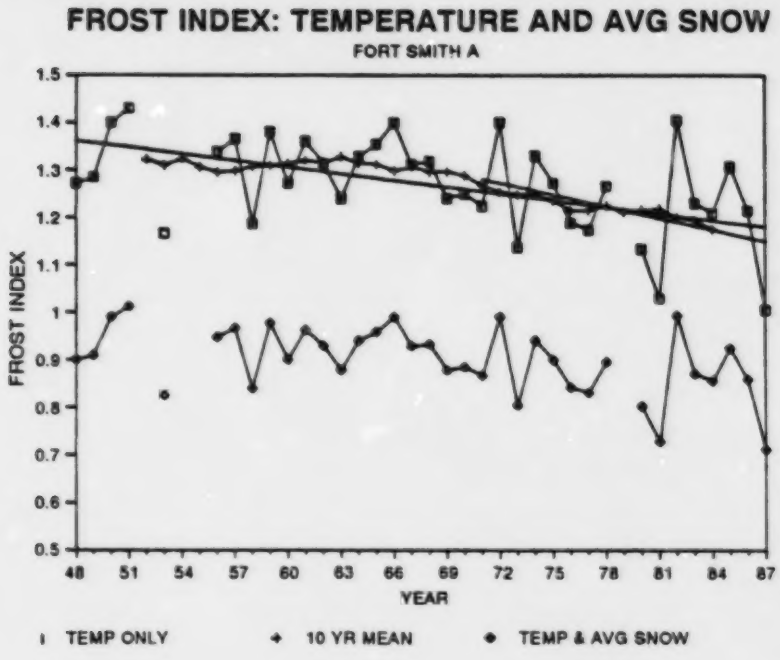


Figure 4.5: For Fort Smith A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period. Also shown is the time series of frost index values assuming that the effect of snow is its average value over the entire period of record ("TEMP AND AVG SNOW").

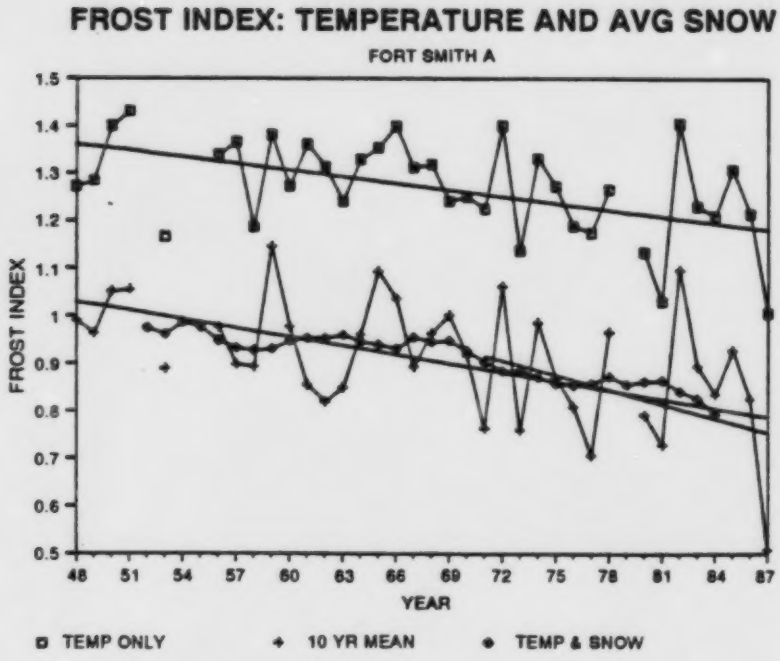


Figure 4.6: For Fort Smith A, the time series of frost index values assuming no snow cover ("TEMP ONLY") is shown along with the best-fit straight line over the entire period of record as in the previous Figure. Also shown is the time series of frost index values assuming actual temperature and snow depth observations ("TEMP AND SNOW") along with the time series of 10 year running mean values for this frost index and the best-fit straight lines for the entire period of record and for the post-1970 period.

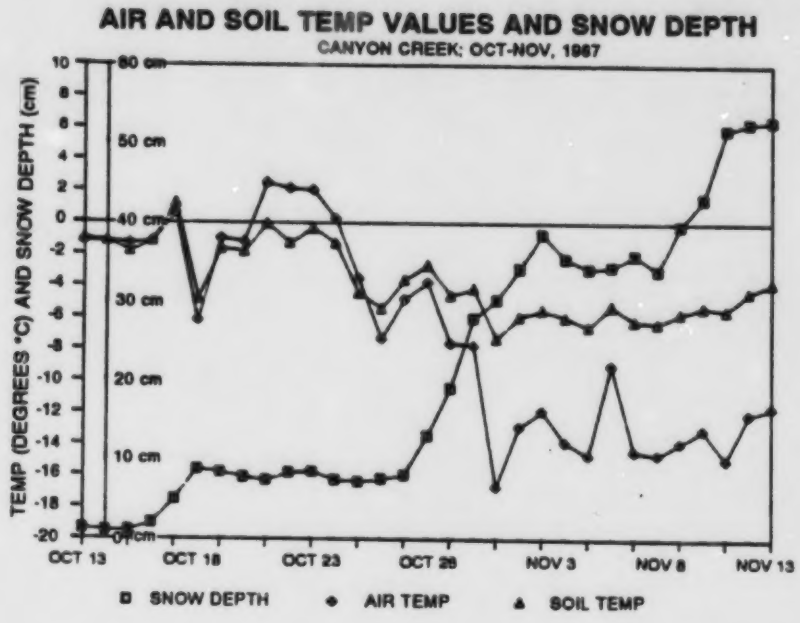


Figure 4.7: The time series of daily mean air temperature, soil temperature at a depth of 0.5 m and daily average snow depth for Canyon Creek is shown for the period October 13 - November 13, 1987.

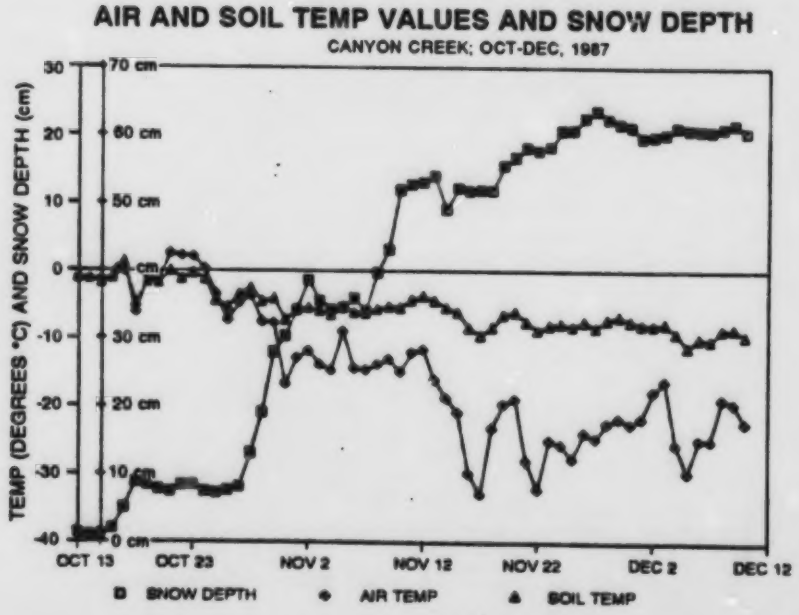


Figure 4.8: As in Figure 4.7 for the time period October 13 - December 12, 1987.

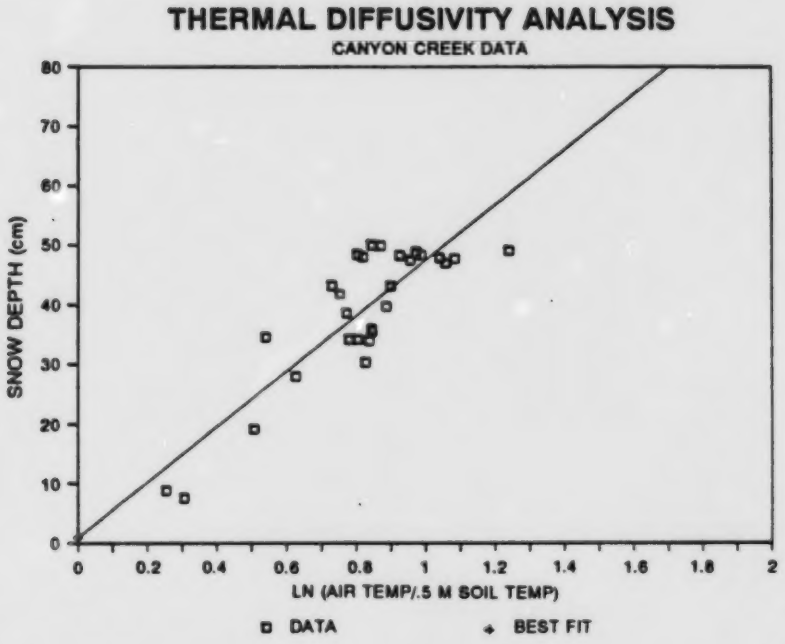


Figure 4.9: Scattergram and best linear fit to all Canyon Creek daily data meeting the following requirements:
Mean daily air temperature < -5 degrees C
Mean daily soil temperature (0.5 m depth) < 0 degrees C
Mean daily snow depth < 50 cm.
For this scattergram the independent variable (X axis) is the natural logarithm of the ratio of air and soil temperatures, and the dependent variable (Y axis) is the snow depth in cm.

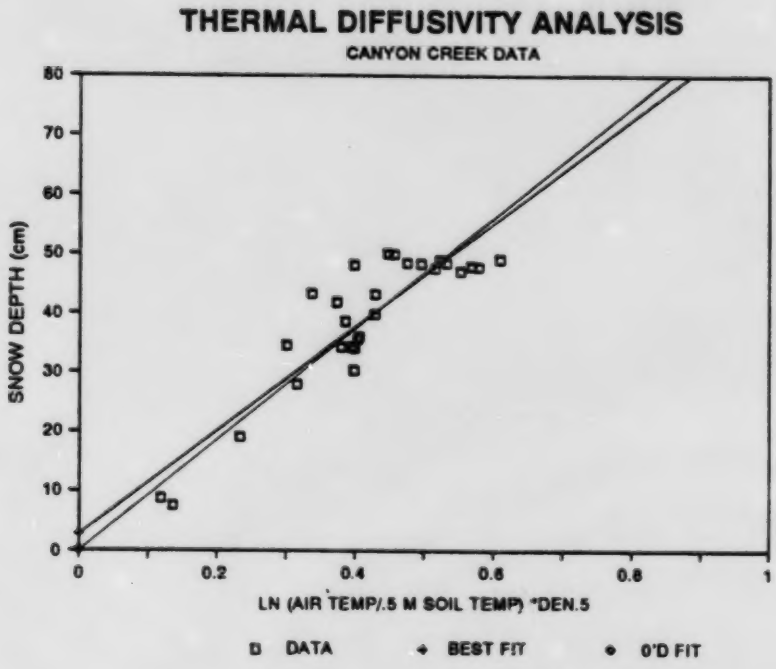


Figure 4.10: Scattergram and best linear fit to all Canyon Creek daily data meeting the following requirements:

Mean daily air temperature < -5 degrees C
Mean daily soil temperature (0.5 m depth) < 0 degrees C
Mean daily snow depth < 50 cm.

For this scattergram the independent variable (X axis) is the product of natural logarithm of the ratio of air and soil temperatures and the square root of the snow density (g cm^{-3}), and the dependent variable (Y axis) is the snow depth in cm. Also shown is the best-fit straight line required to pass through the origin.

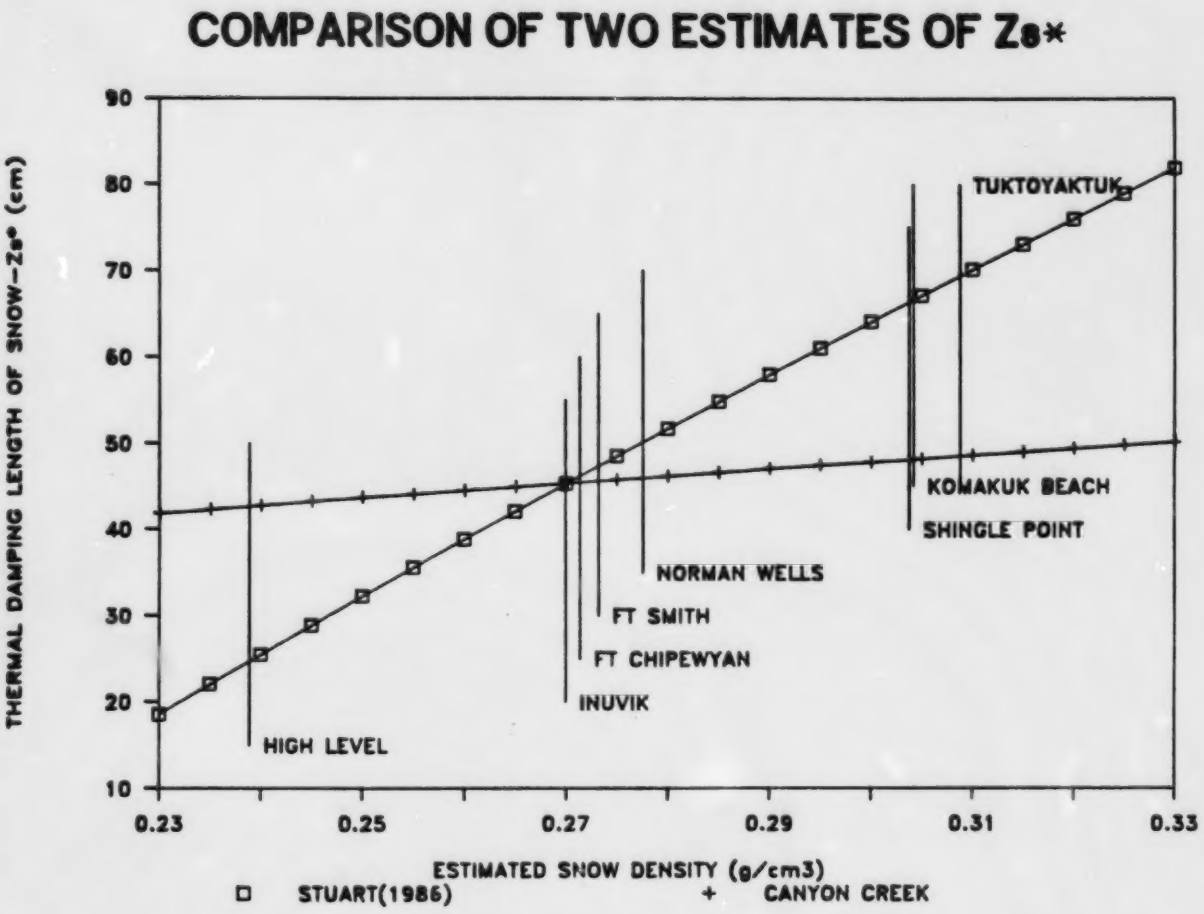


Figure 4.11: The estimated thermal damping lengths of snow, Z_s^*, using two approximation methods, are compared for the range of snow densities found in the study area. Period of record average snow densities for several observing stations are indicated to show the level of agreement of the two methods for each station.

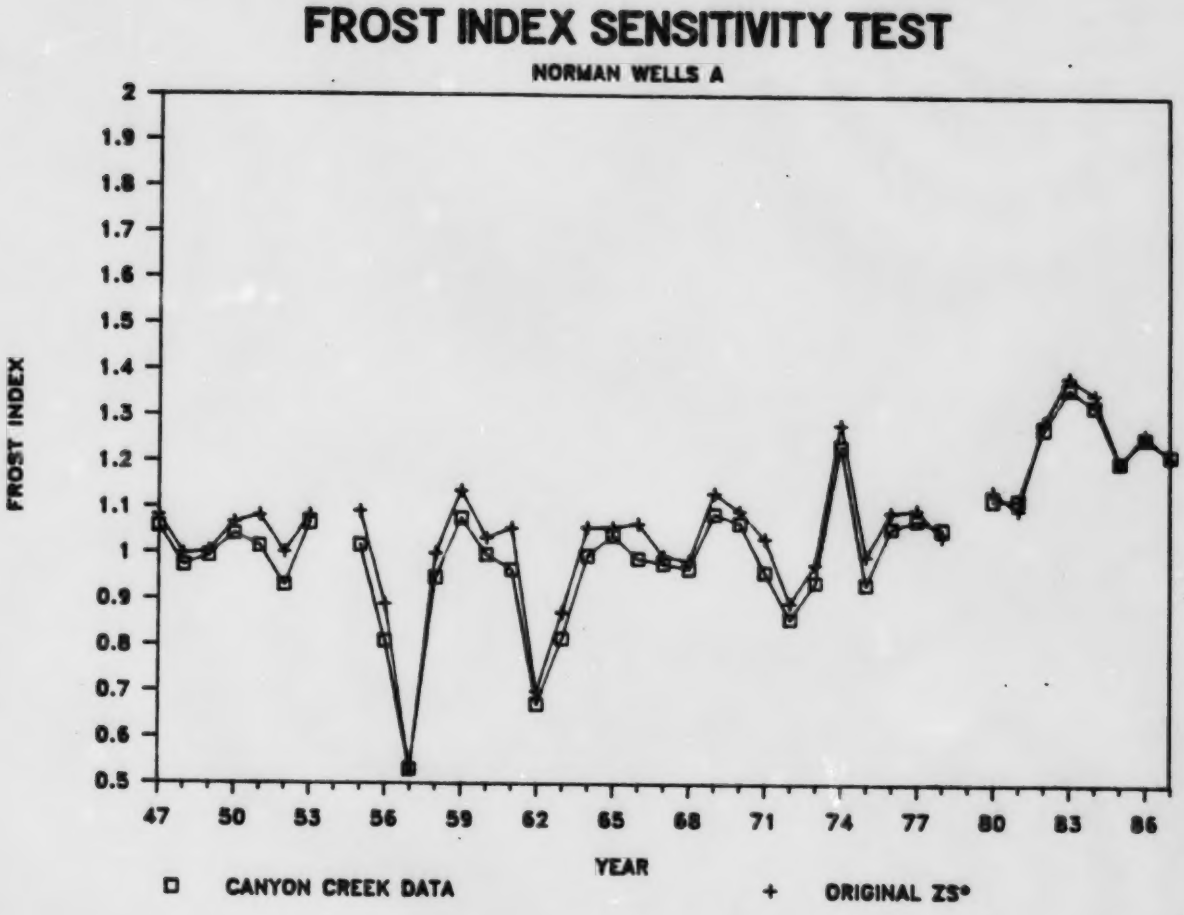


Figure 4.12: The time series of frost index for Norman Wells A is shown for each of the estimation procedures of Z_s^* compared in the previous Figure.

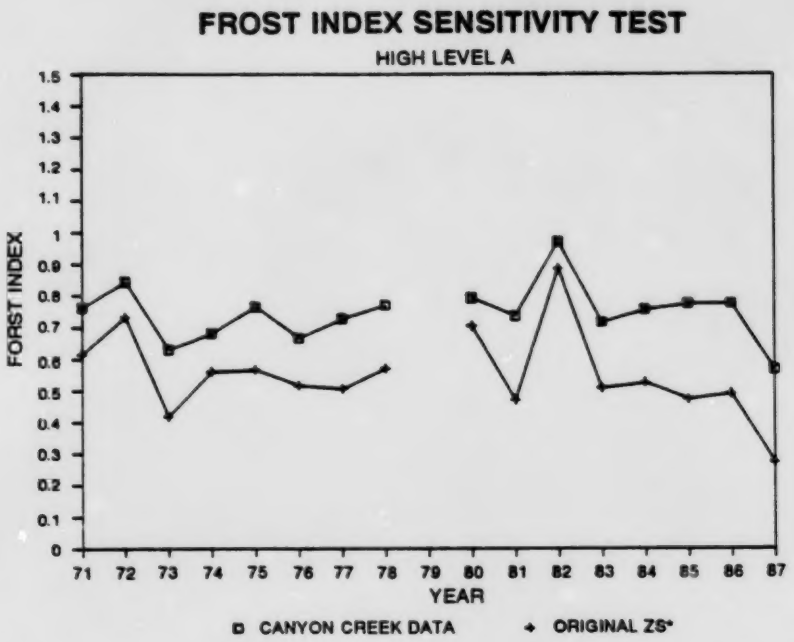


Figure 4.13: The time series of frost index for High Level A is shown for each of the estimation procedures of Z_s^* compared in Figure 4.11.

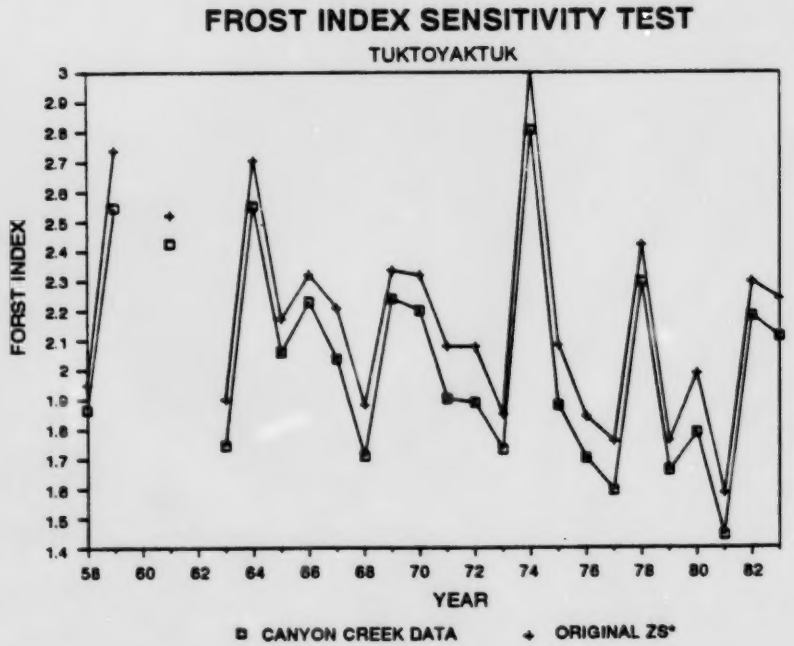


Figure 4.14: The time series of frost index for Tuktoyaktuk is shown for each of the estimation procedures of Z_s^* compared in Figure 4.11.

5. A COMPARISON OF OBSERVATIONS AT NORMAN WELLS AND CANYON CREEK

5.1 INTRODUCTION

In previous chapters we have determined that for most observing stations in the Mackenzie Valley, the climate has been getting warmer, the snow layers, thinner and the climatic support for permafrost layers has been decreasing. These conclusions are strictly applicable only to the observing sites where the necessary air temperature and snow depth measurements are available, and this fact presents a problem to those requiring information concerning other locations that have little or no climate observations.

In their studies of the relationships between climate and permafrost layers along the Norman Wells to Zama pipeline, the Atmospheric Environment Service and the Geological Survey of Canada began making atmospheric and soil observations at Canyon Creek in May, 1986. Canyon Creek is located 19 km from and at an elevation of 75 m above the AES upper air station at Norman Wells. Clearly this time-series of observations is too short to permit conclusions to be drawn concerning temperature or snow depth trends at this station. However, if one can show that a strong correlation exists between simultaneous observations at Canyon Creek and Norman Wells, then the 40 year record at the AES observing station at Norman Wells Airport may be used to infer trends at Canyon Creek. It is this possibility that is examined in this chapter.

The simplest assumption that one can make concerning the relationship between observations at the two stations is that observations at the two sites are identical. This will be referred to as the "no-skill" or "naive" assumption, and it will provide the standard upon which all other algorithms will be judged.

Of all linear algorithms that could be developed to relate Canyon Creek and Norman Wells observations, the one with the lowest root mean square error is obtained by applying a linear regression procedure to all available observations. If this procedure fails to explain a large fraction of the variance then no other linear algorithm can produce a better agreement between estimated and observed values.

We restrict our interest to air temperature and snow depth observations at the two locations. Since the Canyon Creek data does not have a full year of continuous observations as yet, it is not possible to calculate frost index values for this station.

5.2 AIR TEMPERATURE INTERCOMPARISON

In his study of the climate of the Mackenzie Valley Burns (1973) makes a series of critical assumptions concerning the variation of climate parameters as one moves away from the site of the actual observations. For air temperature at elevations higher than the nearby

upper air station, he assumes that the mean temperature observed in the free atmosphere by the sounding at any elevation is equal to all surface temperatures made at the same elevation. This procedure specifies a linear relationship between temperatures at different elevations with a multiplictative factor of unity and an offset proportional to the monthly mean temperature gradient as determined from upper air data. Burns noted that this procedure is very likely to produce errors at higher elevations, but without this assumption he would have been unable to construct his mean monthly temperature maps of the area.

Mean daily air temperatures for Norman Wells A and Canyon Creek are plotted in Figures 5.1 and 5.2. From these Figures, it is clear that temperatures at both stations are highly correlated - a completely expected result for two stations located so close to one another. A regression analysis stratified by month was carried out, and the results are given in Table 5.1. In all months the R-square parameter is greater than or equal to 0.88, indicating that the relationship between mean daily temperature at the two sites is very high. We may conclude from this that linear algorithms such as the Burns application of vertical temperature gradients may be useful in estimating Canyon Creek temperatures. Note, however, that the standard error of the Y estimate exceeds 1°C in all months except September. Since the stations differ in elevation by only 75 m one would expect the typical difference in temperature readings between the stations to be not much greater than this value. From this observation we must conclude that the range between the no-skill estimate and the best linear approximation is very narrow, and this is a matter of some concern.

To test this concern, the root mean square errors of the upper air procedure and the naive procedure were calculated and compared with the errors associated with the best fit. For this test the temperature gradient values used to estimate Canyon Creek temperatures were the mean monthly values of surface to 100 m values obtained from the entire Norman Wells upper air archive. The results are shown in Table 5.2. In eight of the twelve months the no-skill estimate had lower mean errors than the upper air estimate, which would suggest that for these months at least, the upper air method has no skill in the estimation of daily temperatures.

For the purposes of calculating frost indices, however, it is only necessary to be able to estimate mean monthly temperatures and not mean daily temperatures. Perhaps the large errors noted in the estimate of daily temperatures are due to the fact that we have used mean monthly temperature gradients, and the day to day variability will be sufficiently attenuated when monthly mean values at the two stations are estimated and compared with the no-skill option. Unfortunately, the Canyon Creek data base currently has only 30 months of data, so a test of this hypothesis is premature at this time. Despite the limited data base, a time-series of mean monthly errors has been constructed in any case and the resulting mean monthly errors are shown in Figure 5.3. In this Figure the "no-skill" estimate assumes that Canyon Creek and Norman Wells mean monthly temperatures are equal, while the "U/A Avg" estimate uses mean upper air lapse rates as determined from the Norman

Wells upper air data base extending from 1961. The third curve, identified as "U/A Obs" uses mean upper air temperature gradients for the actual month in question instead of average climatology. The fact that only five of the 30 months does the upper air estimate from either the "U/A avg" or "U/A obs" methods result in lower errors than the naive estimate constitutes a strong warning that this approximation may not be worthwhile. Before any firm conclusions may be made in this regard, however, it will be necessary to gather a much larger time-series of mean monthly temperatures.

5.3 SNOW DEPTH INTERCOMPARISON

Given the level of doubt that has already been raised concerning the accuracy of Norman Wells snow depth measurements (see Section 3.4.1), a comparison with Canyon Creek observations is likely to be of limited value. The time-series are plotted in Figures 5.4 and 5.5 for the two winters of data that are presently available. As expected there are large discrepancies in the observations which preclude further progress with this variable. Whether or not these discrepancies can be removed to any extent with Norman Wells snow course data could not be tested in this study because the Norman Wells snow course was discontinued prior to the beginning of observations in Canyon Creek.

5.4 CONCLUSIONS

The time-series of the Canyon Creek data set is currently too short to permit a detailed comparison with Norman Wells A observations. For example, no frost indices could be calculated because of the lack of twelve months of mean temperature and snow depth data for any given year. Not enough mean monthly temperatures are available to estimate the errors associated with the use of upper air data to estimate surface temperatures at locations with higher elevations than the nearby upper air station. A comparison of snow depth values was not possible for this reason as well, and was also hampered by the questionable data at Norman Wells A.

TABLE 5.1: Regression analysis statistics for Norman Wells A (independent variable) and Canyon Creek (dependent variable) daily mean temperatures.

	JAN	FEB	MAR	APR	MAY	JUN
Constant	2.60	1.69	2.00	0.73	0.71	0.44
Std Err of Y Est	1.66	2.00	1.75	1.72	1.41	1.37
R Squared	0.97	0.96	0.96	0.96	0.94	0.89
No. of Observations	39	57	62	60	65	89
Degrees of Freedom	37	55	60	58	63	87
X Coefficient(s)	1.128	1.101	1.096	0.978	0.894	0.980
Std Err of Coef.	0.033	0.030	0.028	0.027	0.029	0.037

	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-0.54	-0.45	-0.23	-0.18	0.50	-4.73	-0.20
Std Err of Y Est	1.19	1.41	0.80	1.72	2.75	3.98	1.97
R Squared	0.89	0.88	0.96	0.94	0.88	0.68	0.99
No. of Observations	89	92	90	93	90	43	869
Degrees of Freedom	87	90	88	91	88	41	867
X Coefficient(s)	1.024	0.994	0.954	0.972	1.062	0.793	1.009
Std Err of Coef.	0.038	0.039	0.020	0.026	0.043	0.086	0.004

TABLE 5.2: Root mean square errors for the estimate of Canyon Creek daily mean temperatures using Norman Wells upper air data are compared with the errors resulting from the "no-skill" assumption that Norman Wells and Canyon Creek surface temperatures are equal.

MONTH	NUMBER OF OBSERVATIONS	RMS ERROR (NO-SKILL EST) [DEGREES C]	RMS ERROR (UPPER AIR EST) [DEGREES C]
JAN	39	1.952	2.341
FEB	57	2.262	2.666
MAR	62	1.928	1.944
APR	60	1.900	1.727
MAY	65	1.525	1.533
JUN	89	1.364	1.356
JUL	89	1.184	1.265
AUG	92	1.496	1.649
SEP	90	0.981	1.081
OCT	93	1.714	1.713
NOV	90	2.890	3.154
DEC	43	4.228	4.587
ANN	869	1.982	2.124

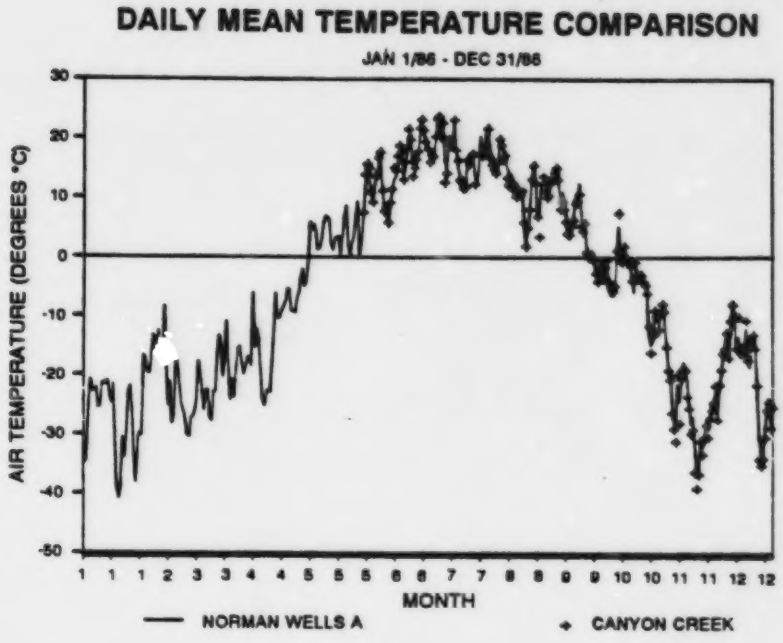


Figure 5.1: The time series of daily mean temperatures is shown for Norman Wells A and for Canyon Creek for the year 1986.

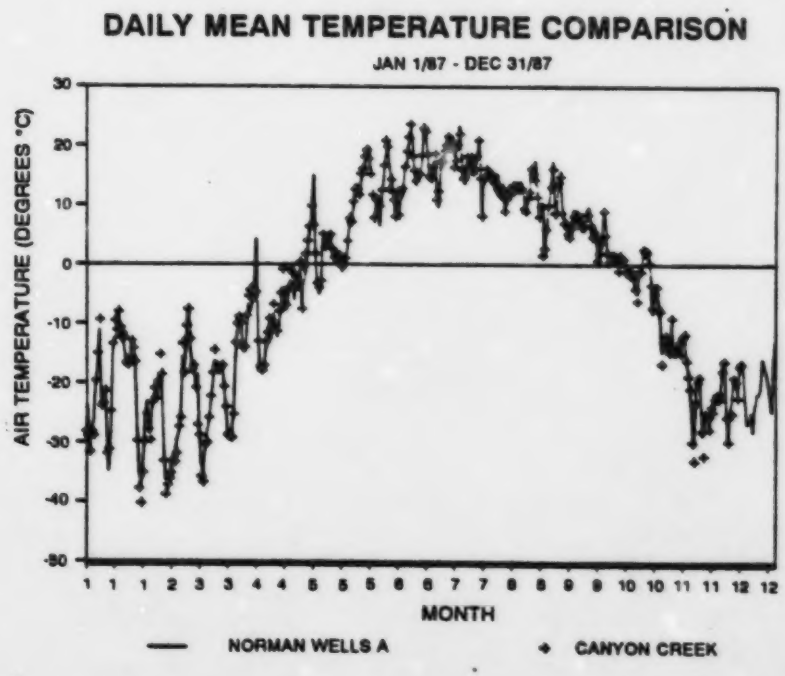


Figure 5.2: The time series of daily mean temperatures is shown for Norman Wells A and for Canyon Creek for the year 1987.

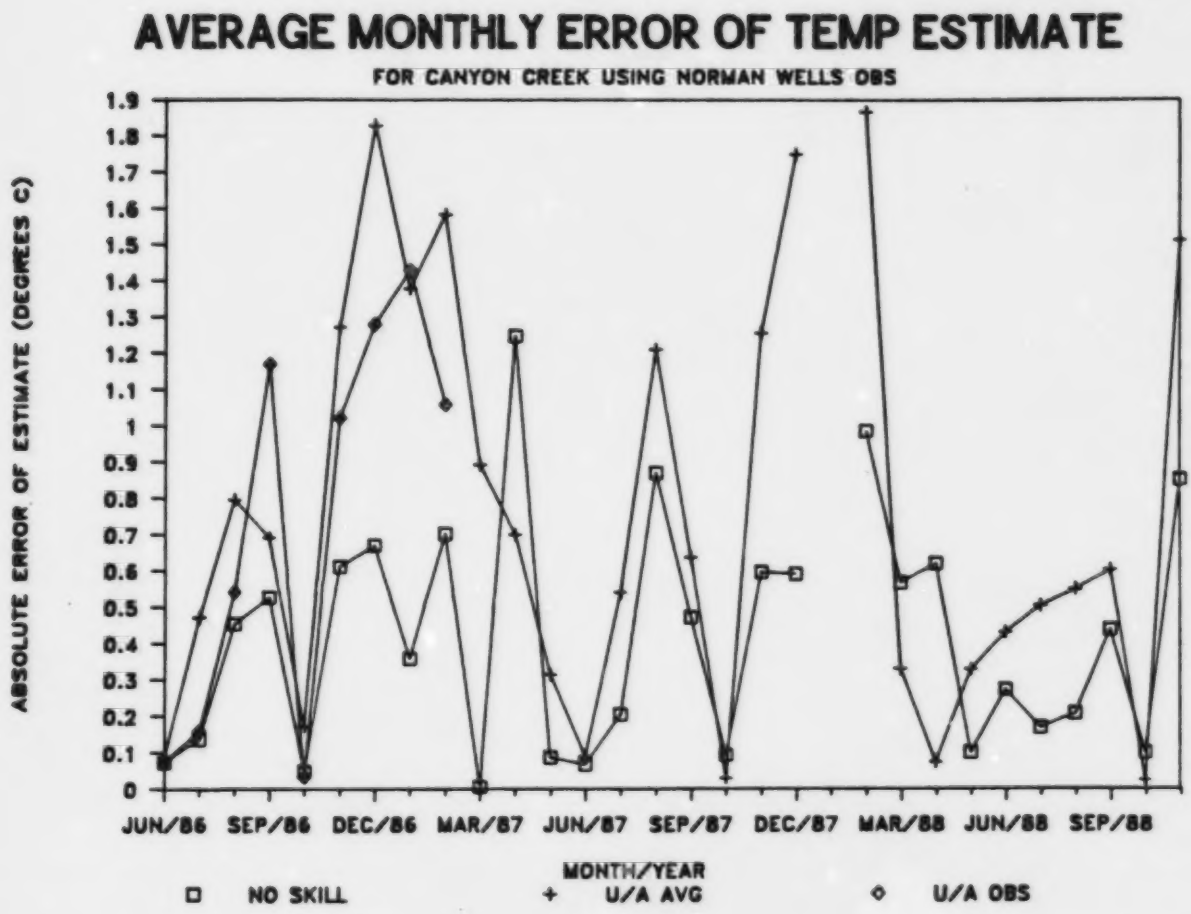


Figure 5.3: The monthly time series of mean absolute error of estimate of several estimation procedures for the mean daily temperature at Canyon Creek is given. These procedures include the "NO SKILL" method which assumes that the Canyon Creek temperature is equal to the value at Norman Wells A, the "U/A AVG" method, which adjusts the Norman Wells temperature according to the average temperature gradient at Norman Wells for the month in question, and the "U/A OBS" method, which adjusts the Norman Wells temperature according to the observed temperature gradient at Norman Wells for the month and year in question.

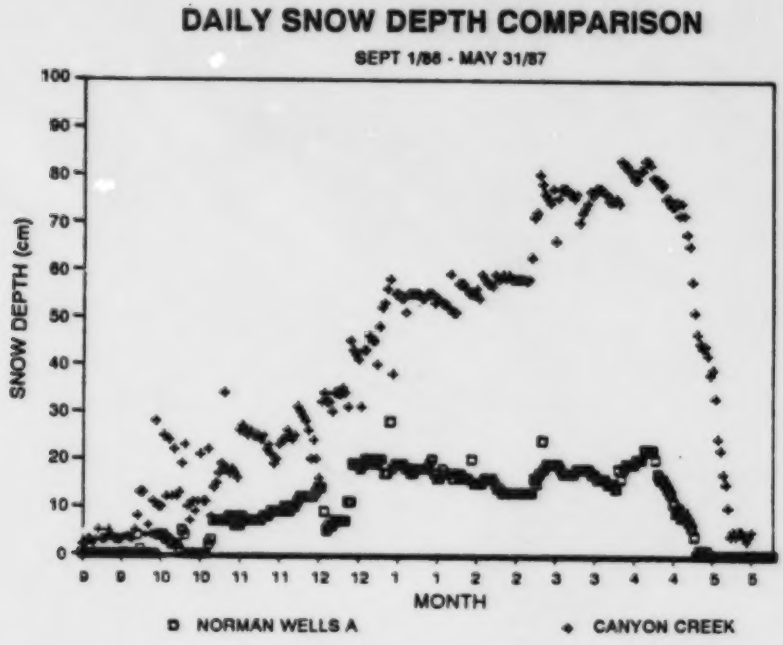


Figure 5.4: The time series of daily mean snow depth is shown for Norman Wells A and for Canyon Creek for the year 1986.

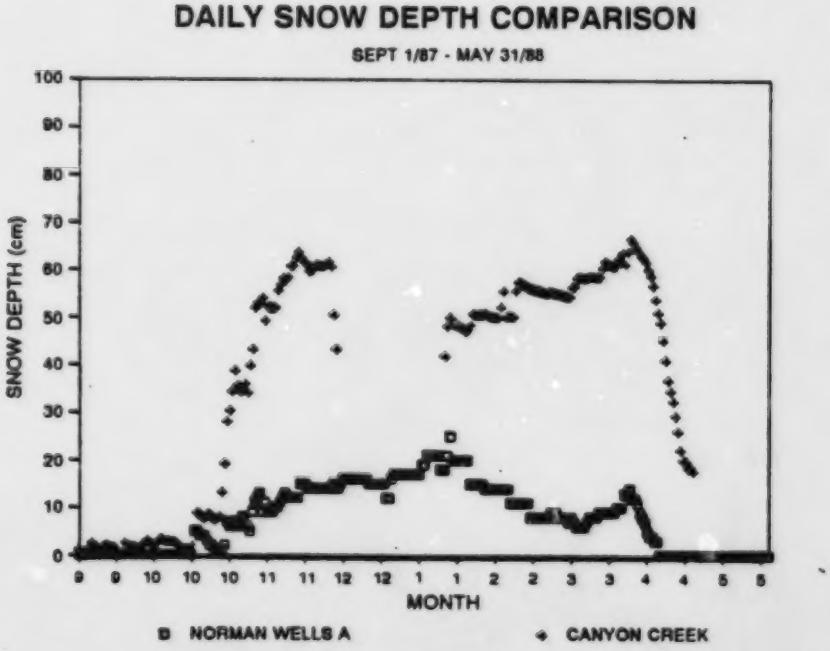


Figure 5.5: The time series of daily mean snow depth is shown for Norman Wells A and for Canyon Creek for the year 1987.

6. STUDY CONCLUSIONS AND RECOMMENDATIONS

In this chapter an attempt is made to amalgamate the results of the various analyses carried out in the course of this project into a broad set of statements that may be used as a basis for further work. No attempt is made here to restate the specific conclusions of the analyses themselves; these are contained elsewhere in this report.

IN THE MACKENZIE VALLEY, TEMPERATURES HAVE BEEN RISING IN WINTER AND ON AN ANNUAL BASIS SINCE 1970; SNOW DEPTHS HAVE BEEN DECREASING AND FROST INDICES, INCREASING.

These are general statements, and some stations show considerable variance from these conclusions. Detailed conclusions for individual stations are given in Chapters 2-4 of this report. It was shown that these conclusions could not be extended beyond the immediate vicinity of the observing stations, and since most of these stations are located near the Mackenzie River, serious information gaps were seen to exist at higher elevations in the Mackenzie Valley. Observing programs specifically targetted to sensitive permafrost areas are required for conclusions to be made concerning these areas.

THE FROST INDEX MODEL HAS BEEN SHOWN TO BE A USEFUL TOOL IN THE EVALUATION OF CLIMATE CHANGE ON SOIL CONDITIONS.

One of the major concerns with the Stuart (1986) frost index model was in the estimation of the thermal damping length of snow cover. In this study, independent data were used to re-evaluate this parameter, and good agreement with previous estimates was obtained for most stations in the Mackenzie Valley area. Even for stations with poor agreement, results concerning frost index trends did not change as a result of the new estimation procedure for Z_s^*. It may therefore be concluded that, provided that accurate and representative observations of monthly temperature means and snow cover depths are available, the frost index model is a useful tool in the determination of the probability of permafrost.

SNOW DEPTH MEASUREMENTS MAY OBSCURE OR REVERSE FROST INDEX TRENDS DUE TO TEMPERATURE CHANGES. FUTURE STUDIES SHOULD USE SNOW COURSE DATA WHENEVER POSSIBLE.

In this study snow depth measurements taken at airports were used in the calculation of frost index values. Intercomparisons with nearby snow course data showed large discrepancies between snow course and airport values, which must be resolved in favour of the snow course values because of their superior observing procedures.

Very low snow depth values since 1980 at Norman Wells A resulted in a reversal of frost index trends at this station from all other stations in the study area with a very high confidence level. These low values were not observed at the Norman Wells snow course, and may be unrepresentative of the general area. Further work will be required to determine the effect of snow course data on the frost index. At a minimum, the frost index model results should be re-evaluated using snow depths measured at all available snow courses in the Mackenzie Valley.

PREVIOUS ATTEMPTS TO EXTRAPOLATE SURFACE TEMPERATURE OBSERVATIONS TO HIGHER ELEVATIONS BY USING UPPER AIR DATA HAVE BEEN CALLED INTO QUESTION. AN IMPROVED UNDERSTANDING OF THE EFFECTS OF ALTITUDE ON AIR TEMPERATURE AND SNOW DEPTH IS ESSENTIAL BEFORE VALLEY OBSERVATIONS MAY BE SAFELY APPLIED TO CONDITIONS AT HIGHER ELEVATIONS.

Using the very brief time-series at Canyon Creek, and comparing temperatures observed here with Norman Wells surface and mean upper air temperature profiles has shown that for stations with elevation differences of less than 100 m, upper air data are not useful in estimating temperatures at higher elevations. Virtually nothing seems to be known about the mean variation of temperature or snow depth with elevation change in the Mackenzie Valley area. Further work in this area is essential if one is to be able to draw conclusions about climate effects in areas that have no direct observations. In particular, a grid of observing stations should be established around each upper air station in the Mackenzie Valley. Observations of daily air temperature, precipitation, wind speed and snow depth are required at a variety of elevations. These results should then be compared with those of other observing programs in which a high spatial resolution in hilly terrain has been achieved.

APPENDIX 1: SURFACE DATA STATISTICS

STATISTICAL SUMMARY OF MONTHLY SNOW COVER, PRECIPITATION AND AIR TEMPERATURE
FOR STATIONS IN THE MACKENZIE VALLEY AREA

STATION	ELEMENT	PARAMETER	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AKLAVIK	SNOW(ALL)	COUNT	15	15	15	15	16	18	18	21	17	15	14	15
AKLAVIK	SNOW(ALL)	AVG	42.666	46.533	46.666	32.8	0	0	0	0	2.9411	16.866	27	38.333
AKLAVIK	SNOW(ALL)	STD_DEV	16.807	19.568	24.794	20.100	0	0	0	0	4.5564	13.215	17.113	21.212
AKLAVIK	SNOW(71-)	COUNT	0	0	0	1	3	5	4	7	4	0	0	1
AKLAVIK	SNOW(71-)	AVG	ERR	ERR	ERR	0	0	0	0	0	0	ERR	ERR	86
AKLAVIK	SNOW(71-)	STD_DEV	ERR	ERR	ERR	0	0	0	0	0	0	ERR	ERR	0
AKLAVIK	PREP(ALL)	COUNT	38	39	35	34	34	35	38	38	40	41	38	35
AKLAVIK	PREP(ALL)	AVG	140.42	112.64	106.62	108.14	113.29	170.14	323.94	359.89	253.8	233.21	180.13	109.6
AKLAVIK	PREP(ALL)	STD_DEV	102.79	123.13	104.69	96.178	124.08	140.20	142.11	228.50	136.55	156.10	157.65	105.41
AKLAVIK	PREP(-71)	COUNT	3	4	3	3	3	3	4	6	6	6	4	2
AKLAVIK	PREP(-71)	AVG	170.66	135.5	190	67	204	86.666	282	383.5	232.66	208.5	168	151
AKLAVIK	PREP(-71)	STD_DEV	38.792	69.200	184.72	49.403	189.53	56.031	56.160	166.68	61.031	79.878	145.59	11
AKLAVIK	TEMP(ALL)	COUNT	36	39	36	37	37	36	35	36	38	40	37	35
AKLAVIK	TEMP(ALL)	AVG	-28.11	-27.36	-22.81	-13.34	-1.013	9.5472	13.611	10.516	3.7131	-7.307	-20.06	-26.86
AKLAVIK	TEMP(ALL)	STD_DEV	3.8088	3.4759	2.7514	2.7462	2.1708	1.8002	1.4340	2.0212	1.8074	2.4699	3.7508	3.1461
AKLAVIK	TEMP(-71)	COUNT	3	5	3	5	5	4	2	4	5	5	5	3
AKLAVIK	TEMP(-71)	AVG	-26.6	-26.7	-23.63	-18.04	-3.18	10.6	14.3	10.075	4.54	-9.1	-22.6	-22.1
AKLAVIK	TEMP(-71)	STD_DEV	2.9131	2.4690	1.6759	3.2481	2.4685	0.2549	1	0.4656	1.4718	3.5377	4.1439	0.7788
AKLAVIK RADIOSONDE	SNOW(ALL)	COUNT	5	5	7	7	6	6	4	7	5	6	6	6
AKLAVIK RADIOSONDE	SNOW(ALL)	AVG	23.8	27.4	26.428	18.428	0	0	0	0	3.2	18	22.333	27
AKLAVIK RADIOSONDE	SNOW(ALL)	STD_DEV	8.3042	12.289	11.311	7.9256	0	0	0	0	5.0358	6.4549	4.8189	6.1913
AKLAVIK RADIOSONDE	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
AKLAVIK RADIOSONDE	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
AKLAVIK RADIOSONDE	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
AKLAVIK RADIOSONDE	PREP(ALL)	COUNT	7	7	8	8	8	8	8	8	7	7	7	7
AKLAVIK RADIOSONDE	PREP(ALL)	AVG	152	85.285	81.375	70.25	74	234.5	347.37	356.87	320.14	300.42	161.85	137.42
AKLAVIK RADIOSONDE	PREP(ALL)	STD_DEV	79.278	65.026	63.792	42.138	35.450	140.85	99.073	182.74	190.58	72.490	71.752	45.878
AKLAVIK RADIOSONDE	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
AKLAVIK RADIOSONDE	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
AKLAVIK RADIOSONDE	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
AKLAVIK RADIOSONDE	TEMP(ALL)	COUNT	7	7	8	8	8	8	8	8	7	7	7	7
AKLAVIK RADIOSONDE	TEMP(ALL)	AVG	-29.3	-28.82	-22.68	-12.85	-1.375	9.4	13.575	10.9	3.9571	-7.8	-21.86	-28.61
AKLAVIK RADIOSONDE	TEMP(ALL)	STD_DEV	3.9752	4.0707	2.9834	2.2754	1.5417	1.8587	1.3970	3.0773	0.9839	1.4860	2.3721	1.3238
AKLAVIK RADIOSONDE	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
AKLAVIK RADIOSONDE	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
AKLAVIK RADIOSONDE	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ANGUS TOWER	SNOW(ALL)	COUNT	0	0	0	0	4	10	8	4	2	0	0	0
ANGUS TOWER	SNOW(ALL)	AVG	ERR	ERR	ERR	ERR	0	0	0	0	0	ERR	ERR	ERR
ANGUS TOWER	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	ERR	0	0	0	0	0	ERR	ERR	ERR
ANGUS TOWER	SNOW(71-)	COUNT	0	0	0	0	2	7	6	3	1	0	0	0
ANGUS TOWER	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	0	0	0	0	0	ERR	ERR	ERR
ANGUS TOWER	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	0	0	0	0	0	ERR	ERR	ERR
ANGUS TOWER	PREP(ALL)	COUNT	0	0	0	0	0	19	17	3	0	0	0	0
ANGUS TOWER	PREP(ALL)	AVG	ERR	ERR	ERR	ERR	ERR	348.89	453.70	443.66	ERR	ERR	ERR	ERR
ANGUS TOWER	PREP(ALL)	STD_DEV	ERR	ERR	ERR	ERR	ERR	188.92	212.82	210.43	ERR	ERR	ERR	ERR
ANGUS TOWER	PREP(-71)	COUNT	0	0	0	0	0	16	15	2	0	0	0	0
ANGUS TOWER	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	379.87	454.93	473.5	ERR	ERR	ERR	ERR
ANGUS TOWER	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	187.76	217.60	252.5	ERR	ERR	ERR	ERR
ANGUS TOWER	TEMP(ALL)	COUNT	0	0	0	0	1	19	16	4	0	0	0	0
ANGUS TOWER	TEMP(ALL)	AVG	ERR	ERR	ERR	ERR	5.3	13.594	16.006	15.325	ERR	ERR	ERR	ERR
ANGUS TOWER	TEMP(ALL)	STD_DEV	ERR	ERR	ERR	ERR	0	0.9461	1.4153	1.5368	ERR	ERR	ERR	ERR
ANGUS TOWER	TEMP(-71)	COUNT	0	0	0	0	1	16	15	3	0	0	0	0
ANGUS TOWER	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	5.3	13.781	16.14	15.966	ERR	ERR	ERR	ERR
ANGUS TOWER	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	0	0.8910	1.3602	1.2256	ERR	ERR	ERR	ERR

ARCTIC RED RIVER	SNOW(ALL)	COUNT	1	1	1	1	1	1	2	2	0	1	1	1
ARCTIC RED RIVER	SNOW(ALL)	AVG	109	97	71	46	0	0	0	0	ERR	61	76	91
ARCTIC RED RIVER	SNOW(ALL)	STD_DEV	0	0	0	0	0	0	0	0	ERR	0	0	0
ARCTIC RED RIVER	SNOW(71-)	COUNT	1	1	1	1	1	1	2	2	0	1	1	1
ARCTIC RED RIVER	SNOW(71-)	AVG	109	97	71	46	0	0	0	0	ERR	61	76	91
ARCTIC RED RIVER	SNOW(71-)	STD_DEV	0	0	0	0	0	0	0	0	ERR	0	0	0
ARCTIC RED RIVER	PREP(ALL)	COUNT	1	1	1	1	1	1	1	1	0	1	1	1
ARCTIC RED RIVER	PREP(ALL)	AVG	152	254	102	279	94	122	307	485	ERR	1562	178	584
ARCTIC RED RIVER	PREP(ALL)	STD_DEV	0	0	0	0	0	0	0	0	ERR	0	0	0
ARCTIC RED RIVER	PREP(-71)	COUNT	1	1	1	1	1	1	1	1	0	1	1	1
ARCTIC RED RIVER	PREP(-71)	AVG	152	254	102	279	94	122	307	485	ERR	1562	178	584
ARCTIC RED RIVER	PREP(-71)	STD_DEV	0	0	0	0	0	0	0	0	ERR	0	0	0
ARCTIC RED RIVER	TEMP(ALL)	COUNT	1	1	1	1	1	0	1	1	0	1	1	1
ARCTIC RED RIVER	TEMP(ALL)	AVG	-39.1	-30.2	-21.7	-12.8	0.5	ERR	13.8	10.3	ERR	-14.6	-23.2	-31.8
ARCTIC RED RIVER	TEMP(ALL)	STD_DEV	0	0	0	0	0	ERR	0	0	ERR	0	0	0
ARCTIC RED RIVER	TEMP(-71)	COUNT	1	1	1	1	1	0	1	1	0	1	1	1
ARCTIC RED RIVER	TEMP(-71)	AVG	-39.1	-30.2	-21.7	-12.8	0.5	ERR	13.8	10.3	ERR	-14.6	-23.2	-31.8
ARCTIC RED RIVER	TEMP(-71)	STD_DEV	0	0	0	0	0	ERR	0	0	ERR	0	0	0
ASSUMPTION	SNOW(ALL)	COUNT	8	10	10	7	7	10	10	10	11	9	8	9
ASSUMPTION	SNOW(ALL)	AVG	54.875	62	60.6	4.4285	0	0	0	0	0	8.2222	18.5	34.888
ASSUMPTION	SNOW(ALL)	STD_DEV	17.694	27.531	38.580	9.6785	0	0	0	0	0	9.5076	12.114	18.272
ASSUMPTION	SNOW(71-)	COUNT	0	1	1	1	0	2	2	1	2	1	0	1
ASSUMPTION	SNOW(71-)	AVG	ERR	28	84	0	ERR	0	0	0	0	0	ERR	18
ASSUMPTION	SNOW(71-)	STD_DEV	ERR	0	0	0	ERR	0	0	0	0	0	ERR	0
ASSUMPTION	PREP(ALL)	COUNT	10	11	11	10	9	10	10	9	10	11	11	11
ASSUMPTION	PREP(ALL)	AVG	211	207.36	283.18	165.2	266.66	547.1	869.4	516.22	324.3	269.90	228.18	249.45
ASSUMPTION	PREP(ALL)	STD_DEV	67.077	115.37	146.45	166.40	176.70	442.45	220.52	300.58	116.94	181.99	118.69	133.03
ASSUMPTION	PREP(-71)	COUNT	1	2	2	2	1	2	2	1	1	2	2	2
ASSUMPTION	PREP(-71)	AVG	272	158.5	390	75	368	638.5	854.5	853	114	86.5	220	292
ASSUMPTION	PREP(-71)	STD_DEV	0	120.5	1	22	0	265.5	346.5	0	0	50.5	217	114
ASSUMPTION	TEMP(ALL)	COUNT	10	11	11	10	9	10	10	10	10	11	11	11
ASSUMPTION	TEMP(ALL)	AVG	-25.07	-17.99	-12.06	0.82	9.0333	13.64	15.91	14.21	7.97	2.0272	-12.15	-19.65
ASSUMPTION	TEMP(ALL)	STD_DEV	4.0679	3.4302	4.1534	1.9098	1.1065	0.6036	1.2809	1.3087	1.7927	1.7954	3.7112	4.5563
ASSUMPTION	TEMP(-71)	COUNT	1	2	2	2	1	2	2	1	1	2	2	2
ASSUMPTION	TEMP(-71)	AVG	-26.2	-19.4	-14.45	1.9	10.8	14.1	16.65	14	7.5	1.85	-12.6	-17.7
ASSUMPTION	TEMP(-71)	STD_DEV	0	0.3	1.45	0.4	0	0.3	1.75	0	0	0.15	5.2	2.3
ATKINSON POINT	SNOW(ALL)	COUNT	5	5	5	4	5	2	3	4	4	3	3	4
ATKINSON POINT	SNOW(ALL)	AVG	23	26.4	29	33.75	5.2	0	0	0	0	11	9.3333	14.75
ATKINSON POINT	SNOW(ALL)	STD_DEV	8.9442	11.038	10.751	11.691	6.6753	0	0	0	0	8.4852	6.1282	8.3179
ATKINSON POINT	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
ATKINSON POINT	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ATKINSON POINT	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ATKINSON POINT	PREP(ALL)	COUNT	4	4	4	4	4	5	5	5	4	4	4	3
ATKINSON POINT	PREP(ALL)	AVG	45.75	28.5	45.75	78.25	88	96.4	339.4	335.2	152.75	143.5	12.75	28
ATKINSON POINT	PREP(ALL)	STD_DEV	49.149	25.184	31.617	88.225	71.655	64.617	59.149	115.18	88.346	135.96	13.808	29.631
ATKINSON POINT	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
ATKINSON POINT	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ATKINSON POINT	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ATKINSON POINT	TEMP(ALL)	COUNT	4	4	3	5	4	5	5	5	4	4	4	2
ATKINSON POINT	TEMP(ALL)	AVG	-29.95	-27.22	-29.66	-17.64	-6.625	3.18	8.24	7.3	1.15	-8.1	-21.97	-24.95
ATKINSON POINT	TEMP(ALL)	STD_DEV	3.3974	1.9149	2.1171	2.6104	2.3647	1.7656	1.9158	1.9565	0.8291	2.6391	2.0017	2.05
ATKINSON POINT	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
ATKINSON POINT	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
ATKINSON POINT	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
CADILLAC MINE	SNOW(ALL)	COUNT	1	0	1	0	1	2	2	2	1	0	1	0
CADILLAC MINE	SNOW(ALL)	AVG	33	ERR	0	ERR	0	0	0	0	0	ERR	10	ERR
CADILLAC MINE	SNOW(ALL)	STD_DEV	0	ERR	0	ERR	0	0	0	0	0	ERR	0	ERR
CADILLAC MINE	SNOW(71-)	COUNT	0	0	1	0	1	1	1	1	0	0	1	0

CADILLAC MINE	SNOW(71-)	AVG	ERR	ERR	0	ERR	0	0	0	0	ERR	ERR	10	ERR
CADILLAC MINE	SNOW(71-)	STD_DEV	ERR	ERR	0	ERR	0	0	0	0	ERR	ERR	0	ERR
CADILLAC MINE	PREP(ALL)	COUNT	2	3	2	1	2	2	2	2	2	2	3	2
CADILLAC MINE	PREP(ALL)	AVG	214.5	176.33	104	322	378	921.5	915	1278.5	802.5	408	201.66	243
CADILLAC MINE	PREP(ALL)	STD_DEV	120.5	127.01	96	0	222	68.5	182	788.5	111.5	129	36.380	18
CADILLAC MINE	PREP(-71)	COUNT	2	2	1	1	2	1	1	1	1	1	2	2
CADILLAC MINE	PREP(-71)	AVG	214.5	229	200	322	378	990	753	510	491	537	216	243
CADILLAC MINE	PREP(-71)	STD_DEV	120.5	126	0	0	222	0	0	0	0	0	37	18
CADILLAC MINE	TEMP(ALL)	COUNT	2	3	3	2	3	2	2	2	2	2	3	2
CADILLAC MINE	TEMP(ALL)	AVG	-24.4	-18.7	-12.26	-4.8	5.8333	10.35	13.25	11.3	4.8	-4.6	-12.9	-26.3
CADILLAC MINE	TEMP(ALL)	STD_DEV	11.2	3.1506	3.2427	1.5	1.4817	0.35	1.15	0.9	0.8	0.3	3.1843	3.3
CADILLAC MINE	TEMP(-71)	COUNT	2	2	2	1	2	1	1	1	1	1	2	2
CADILLAC MINE	TEMP(-71)	AVG	-24.4	-20.55	-13.1	-8.3	8.2	10	14.4	12.2	5.8	-4.3	-10.85	-26.3
CADILLAC MINE	TEMP(-71)	STD_DEV	11.2	2.15	3.7	0	1.7	0	0	0	0	0	0.15	3.3
FINNEGAN	SNOW(ALL)	COUNT	4	3	4	2	3	5	5	5	5	4	4	4
FINNEGAN	SNOW(ALL)	AVG	28.5	38.333	26	0	0	0	0	0	0	0	4.5	15.75
FINNEGAN	SNOW(ALL)	STD_DEV	17.684	2.0548	26.009	0	0	0	0	0	0	0	4.5552	4.8589
FINNEGAN	SNOW(71-)	COUNT	4	3	4	2	3	4	4	4	4	3	3	3
FINNEGAN	SNOW(71-)	AVG	28.5	38.333	26	0	0	0	0	0	0	0	2.6666	13.333
FINNEGAN	SNOW(71-)	STD_DEV	17.684	2.0548	26.009	0	0	0	0	0	0	0	3.7712	2.3570
FINNEGAN	PREP(ALL)	COUNT	5	5	4	4	4	5	5	5	5	5	5	5
FINNEGAN	PREP(ALL)	AVG	309.8	231.2	147.5	150.75	241.25	807.2	242	406	200.4	131.8	95.2	193.6
FINNEGAN	PREP(ALL)	STD_DEV	248.72	82.821	71.096	92.567	152.03	411.38	132.94	287.55	119.79	147.30	52.346	40.637
FINNEGAN	PREP(-71)	COUNT	5	5	4	4	4	4	4	4	4	4	4	4
FINNEGAN	PREP(-71)	AVG	309.8	231.2	147.5	150.75	241.25	633.75	247.25	493.5	217.5	59.25	93.5	207
FINNEGAN	PREP(-71)	STD_DEV	248.72	82.821	71.096	92.567	152.03	247.23	148.17	255.09	128.35	28.384	58.401	34.154
FINNEGAN	TEMP(ALL)	COUNT	5	5	4	3	4	5	5	5	5	5	5	5
FINNEGAN	TEMP(ALL)	AVG	-15.8	-12.78	-6.7	3.8333	10.725	16.02	17.52	17.98	10	4.74	-5.98	-13.34
FINNEGAN	TEMP(ALL)	STD_DEV	3.3757	2.9444	3.2007	0.2624	1.3772	1.24	0.9558	2.0624	1.1865	1.5679	4.2990	4.5993
FINNEGAN	TEMP(-71)	COUNT	5	5	4	3	4	4	4	4	4	4	4	4
FINNEGAN	TEMP(-71)	AVG	-15.8	-12.78	-6.7	3.8333	10.725	15.575	17.225	18	9.975	4.95	-5.225	-12.6
FINNEGAN	TEMP(-71)	STD_DEV	3.3757	2.9444	3.2007	0.2624	1.3772	0.9653	0.8407	2.3054	1.3254	1.6889	4.5002	4.8687
FOOTNER LAKE HQ	SNOW(ALL)	COUNT	2	2	2	2	3	3	3	3	3	2	2	2
FOOTNER LAKE HQ	SNOW(ALL)	AVG	42	42	38	0	0	0	0	0	0	1.5	16.5	27.5
FOOTNER LAKE HQ	SNOW(ALL)	STD_DEV	6	1	18	0	0	0	0	0	0	1.5	3.5	2.5
FOOTNER LAKE HQ	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FOOTNER LAKE HQ	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FOOTNER LAKE HQ	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FOOTNER LAKE HQ	PREP(ALL)	COUNT	2	2	2	2	2	3	3	3	3	2	2	2
FOOTNER LAKE HQ	PREP(ALL)	AVG	183	219.5	298.5	199.5	259.5	262.33	1092	462.33	403.66	186.5	332.5	160.5
FOOTNER LAKE HQ	PREP(ALL)	STD_DEV	81	82.5	115.5	158.5	162.5	200.71	417.11	115.06	118.99	54.5	63.5	63.5
FOOTNER LAKE HQ	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FOOTNER LAKE HQ	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FOOTNER LAKE HQ	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FOOTNER LAKE HQ	TEMP(ALL)	COUNT	2	2	2	2	2	3	3	3	3	2	2	2
FOOTNER LAKE HQ	TEMP(ALL)	AVG	-30.3	-17.75	-7.6	2.45	8.6	12.6	14.333	13	7.9	1.25	-9.9	-22.05
FOOTNER LAKE HQ	TEMP(ALL)	STD_DEV	3.4	1.05	2	1.65	0.1	0.2160	0.8219	1.5121	1.7146	0.05	1.4	3.45
FOOTNER LAKE HQ	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FOOTNER LAKE HQ	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FOOTNER LAKE HQ	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT CHIPEWYAN	SNOW(ALL)	COUNT	5	5	5	5	5	5	5	5	5	6	5	5
FORT CHIPEWYAN	SNOW(ALL)	AVG	47.2	61.6	61.8	2.2	0	0	0	0	0	3.1666	17.8	30.2
FORT CHIPEWYAN	SNOW(ALL)	STD_DEV	13.891	13.078	21.029	3.1240	0	0	0	0	0	4.5977	6.6753	10.870
FORT CHIPEWYAN	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT CHIPEWYAN	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT CHIPEWYAN	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT CHIPEWYAN	PREP(ALL)	COUNT	47	45	45	41	50	48	52	51	47	45	51	48
FORT CHIPEWYAN	PREP(ALL)	AVG	187.02	177.73	180.75	193.75	222.94	345.27	519.26	413.23	381.06	225.91	244.49	216.22

FORT CHIPEWYAN	PREP(ALL)	STD_DEV	99.438	149.52	97.052	116.65	163.51	207.44	426.85	248.43	238.43	163.10	147.27	150.14
FORT CHIPEWYAN	PREP(-71)	COUNT	4	3	4	4	3	2	3	3	3	2	5	5
FORT CHIPEWYAN	PREP(-71)	AVG	182	314	267.75	127.75	105.66	460	505.66	181.33	456	217	189.6	226
FORT CHIPEWYAN	PREP(-71)	STD_DEV	76.154	214.13	113.58	97.088	15.542	15	94.206	88.039	226.05	103	92.791	101.58
FORT CHIPEWYAN	TEMP(ALL)	COUNT	52	56	55	58	53	50	52	51	48	51	53	56
FORT CHIPEWYAN	TEMP(ALL)	AVG	-25.04	-21.56	-15.13	-2.703	6.7641	13.172	16.884	14.603	8.1791	1.1058	-10.62	-19.16
FORT CHIPEWYAN	TEMP(ALL)	STD_DEV	4.2378	4.7510	3.5849	3.7544	2.2896	1.7007	1.4319	1.6851	2.0488	2.4953	3.5522	4.4024
FORT CHIPEWYAN	TEMP(-71)	COUNT	4	4	4	4	4	3	3	3	3	3	5	5
FORT CHIPEWYAN	TEMP(-71)	AVG	-29.12	-24.82	-18.52	-3.35	5.525	14.433	16.166	13.7	6.7666	-0.766	-11	-19.22
FORT CHIPEWYAN	TEMP(-71)	STD_DEV	3.0433	2.0461	1.7823	1.0828	0.9832	1.6131	0.3091	0.4242	1.5584	1.8553	3.7501	5.9984
FORT CHIPEWYAN A	SNOW(ALL)	COUNT	16	17	17	18	20	20	20	20	19	15	17	17
FORT CHIPEWYAN A	SNOW(ALL)	AVG	50.812	57.235	46.470	0.3888	0	0	0	0	0.1578	1.0666	15.882	33.058
FORT CHIPEWYAN A	SNOW(ALL)	STD_DEV	16.109	21.563	24.949	1.0076	0	0	0	0	0.6698	2.1437	7.7070	10.479
FORT CHIPEWYAN A	SNOW(71-)	COUNT	13	14	14	15	17	17	17	17	16	12	13	13
FORT CHIPEWYAN A	SNOW(71-)	AVG	50.769	56.785	48.642	0.4666	0	0	0	0	0.1875	0.8333	15.846	33.615
FORT CHIPEWYAN A	SNOW(71-)	STD_DEV	16.627	22.475	26.916	1.0873	0	0	0	0	0.7261	2.2298	8.3743	10.824
FORT CHIPEWYAN A	PREP(ALL)	COUNT	18	20	20	20	20	20	20	20	20	20	21	20
FORT CHIPEWYAN A	PREP(ALL)	AVG	208.05	141.2	178.9	200.45	294.3	472.3	628.5	481.7	405.8	332.95	223.47	221.1
FORT CHIPEWYAN A	PREP(ALL)	STD_DEV	74.543	68.697	80.439	138.33	148.49	284.33	261.93	191.03	220.81	210.36	88.666	79.485
FORT CHIPEWYAN A	PREP(-71)	COUNT	15	17	17	17	17	17	17	17	17	17	17	16
FORT CHIPEWYAN A	PREP(-71)	AVG	213.06	146.35	175.35	193.70	253.76	491.82	674.82	480.70	396.11	352.23	214.94	245.93
FORT CHIPEWYAN A	PREP(-71)	STD_DEV	75.257	72.184	81.785	134.79	103.13	289.57	252.77	184.81	225.99	213.28	91.249	66.628
FORT CHIPEWYAN A	TEMP(ALL)	COUNT	19	20	20	20	20	20	20	20	20	20	21	20
FORT CHIPEWYAN A	TEMP(ALL)	AVG	-24.48	-19.57	-12.24	-0.055	8.46	14.03	16.295	14.535	8.195	1.17	-10.72	-20.04
FORT CHIPEWYAN A	TEMP(ALL)	STD_DEV	4.8641	4.6728	2.8023	2.9516	2.0397	1.2260	1.2375	1.9486	1.7959	1.5947	3.8378	4.6619
FORT CHIPEWYAN A	TEMP(-71)	COUNT	16	17	17	17	17	17	17	17	17	17	17	16
FORT CHIPEWYAN A	TEMP(-71)	AVG	-23.83	-19.69	-12.31	-0.058	8.7470	14.2	16.447	14.558	8.2941	1.3	-10.89	-20.29
FORT CHIPEWYAN A	TEMP(-71)	STD_DEV	4.8569	5.0230	2.8615	3.1479	2.0640	0.8798	1.1822	2.0496	1.9307	1.6036	4.1403	4.6102
FORT GOOD HOPE	SNOW(ALL)	COUNT	28	27	25	27	29	31	26	28	23	24	25	29
FORT GOOD HOPE	SNOW(ALL)	AVG	58	63.851	66.52	34.962	0.1034	0	0	0	0.7826	17.958	30.6	46.482
FORT GOOD HOPE	SNOW(ALL)	STD_DEV	19.584	24.041	20.878	24.968	0.5473	0	0	0	1.7434	13.599	18.447	16.882
FORT GOOD HOPE	SNOW(71-)	COUNT	12	11	10	11	14	15	12	14	10	10	9	12
FORT GOOD HOPE	SNOW(71-)	AVG	52.666	56.818	58.3	32.090	0	0	0	0	0.3	17.4	27.555	38.416
FORT GOOD HOPE	SNOW(71-)	STD_DEV	12.160	21.400	17.082	27.503	0	0	0	0	0.9	12.665	12.876	12.592
FORT GOOD HOPE	PREP(ALL)	COUNT	38	38	36	38	35	36	35	36	34	35	38	36
FORT GOOD HOPE	PREP(ALL)	AVG	161.76	117.13	109.69	130.78	144.31	297.33	415.08	451.38	283.29	273.45	201.97	173.89
FORT GOOD HOPE	PREP(ALL)	STD_DEV	115.96	87.787	76.200	100.28	119.05	201.43	279.65	330.50	158.62	158.96	106.51	100.80
FORT GOOD HOPE	PREP(-71)	COUNT	14	13	11	12	12	13	10	12	11	10	12	10
FORT GOOD HOPE	PREP(-71)	AVG	166.85	121.69	107	181.83	153.83	243.76	425.8	389.25	208.63	310.5	172.16	140
FORT GOOD HOPE	PREP(-71)	STD_DEV	101.82	81.588	60.524	106.76	130.33	213.23	219.50	275.90	90.502	166.59	61.144	91.908
FORT GOOD HOPE	TEMP(ALL)	COUNT	33	36	36	34	37	35	32	36	36	35	35	34
FORT GOOD HOPE	TEMP(ALL)	AVG	-30.63	-28.54	-21.31	-9.485	3.8918	13.634	16.193	12.677	5.375	-5.874	-20.77	-27.34
FORT GOOD HOPE	TEMP(ALL)	STD_DEV	4.3465	3.8564	3.3977	2.8325	1.9241	1.8518	1.0154	1.7291	1.5433	2.5719	3.3597	4.0698
FORT GOOD HOPE	TEMP(-71)	COUNT	10	12	11	9	12	11	8	10	10	10	10	9
FORT GOOD HOPE	TEMP(-71)	AVG	-29.83	-28.07	-23.08	-9.7	4.0916	14.7	16.9	12.77	6.03	-7.01	-22.2	-27.52
FORT GOOD HOPE	TEMP(-71)	STD_DEV	3.9897	3.9975	2.2100	2.7724	2.5018	1.5045	0.9617	1.1739	1.7994	2.0839	2.9291	4.6374
FORT GOOD HOPE 2	SNOW(ALL)	COUNT	15	15	16	10	10	10	12	14	12	13	12	12
FORT GOOD HOPE 2	SNOW(ALL)	AVG	56.466	62.666	62.875	33.9	1.3	0	0	0	1.0833	22.538	35.75	41.416
FORT GOOD HOPE 2	SNOW(ALL)	STD_DEV	18.449	22.107	19.367	15.036	3.9	0	0	0	2.4986	9.1367	11.797	19.332
FORT GOOD HOPE 2	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT GOOD HOPE 2	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT GOOD HOPE 2	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT GOOD HOPE 2	PREP(ALL)	COUNT	61	63	63	61	62	60	60	62	60	64	64	63
FORT GOOD HOPE 2	PREP(ALL)	AVG	156.01	141.03	144.73	136.49	169.16	279.61	407.86	463.41	301.65	281.03	246.01	171.20
FORT GOOD HOPE 2	PREP(ALL)	STD_DEV	107.44	106.84	141.82	101.69	123.71	156.29	254.60	296.87	158.44	160.31	163.01	111.21
FORT GOOD HOPE 2	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT GOOD HOPE 2	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT GOOD HOPE 2	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

FORT GOOD HOPE 2	TEMP(ALL)	COUNT	56	57	57	57	57	57	55	58	59	59	59	58
FORT GOOD HOPE 2	TEMP(ALL)	AVG	-30.88	-28.82	-22.87	-10.17	3.5719	12.884	15.24	11.934	4.5796	-6.033	-21.23	-28.32
FORT GOOD HOPE 2	TEMP(ALL)	STD_DEV	4.5832	4.1332	3.3615	2.9749	1.8418	1.8285	1.3992	1.5414	1.7316	2.4417	3.4851	3.7860
FORT GOOD HOPE 2	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT GOOD HOPE 2	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT GOOD HOPE 2	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT LIARD	SNOW(ALL)	COUNT	10	8	11	12	12	14	14	15	13	9	10	11
FORT LIARD	SNOW(ALL)	AVG	43.3	52.25	41.909	9.3333	0	0	0	0	0	25.777	19.2	27.727
FORT LIARD	SNOW(ALL)	STD_DEV	18.493	12.007	25.137	12.578	0	0	0	0	0	37.552	12.480	15.960
FORT LIARD	SNOW(71-)	COUNT	10	8	11	12	12	14	14	15	13	9	10	11
FORT LIARD	SNOW(71-)	AVG	43.3	52.25	41.909	9.3333	0	0	0	0	0	25.777	19.2	27.727
FORT LIARD	SNOW(71-)	STD_DEV	18.493	12.007	25.137	12.578	0	0	0	0	0	37.552	12.480	15.960
FORT LIARD	PREP(ALL)	COUNT	13	12	14	14	13	14	13	15	15	15	14	13
FORT LIARD	PREP(ALL)	AVG	218.23	174.91	220.78	255.28	386.61	566	842	848.66	429.33	286.86	227.85	195.76
FORT LIARD	PREP(ALL)	STD_DEV	140.62	148.58	98.016	242.71	222.52	307.95	522.07	286.60	197.12	271.48	154.46	114.68
FORT LIARD	PREP(-71)	COUNT	13	12	14	14	13	14	13	15	15	15	14	13
FORT LIARD	PREP(-71)	AVG	218.23	174.91	220.78	255.28	386.61	566	842	848.66	429.33	286.86	227.85	195.76
FORT LIARD	PREP(-71)	STD_DEV	140.62	148.58	98.016	242.71	222.52	307.95	522.07	286.60	197.12	271.48	154.46	114.68
FORT LIARD	TEMP(ALL)	COUNT	13	13	14	14	13	14	13	15	15	15	14	13
FORT LIARD	TEMP(ALL)	AVG	-21.76	-18.48	-11.25	1.6214	9.5	15.042	17.053	14.353	9.6533	0.7666	-13.77	-20.66
FORT LIARD	TEMP(ALL)	STD_DEV	6.0864	5.3908	4.1121	2.4346	1.6571	1.0019	1.2388	1.1289	1.5085	2.3436	5.0000	5.3810
FORT LIARD	TEMP(-71)	COUNT	13	13	14	14	13	14	13	15	15	15	14	13
FORT LIARD	TEMP(-71)	AVG	-21.76	-18.48	-11.25	1.6214	9.5	15.042	17.053	14.353	9.6533	0.7666	-13.77	-20.66
FORT LIARD	TEMP(-71)	STD_DEV	6.0864	5.3908	4.1121	2.4346	1.6571	1.0019	1.2388	1.1289	1.5085	2.3436	5.0000	5.3810
FORT MCPHERSON	SNOW(ALL)	COUNT	10	9	12	6	8	17	14	14	12	12	9	10
FORT MCPHERSON	SNOW(ALL)	AVG	47	46.555	67.083	47.833	0	0	0	0	0.6666	21.833	41.444	47.7
FORT MCPHERSON	SNOW(ALL)	STD_DEV	31.164	34.679	21.398	26.610	0	0	0	0	1.5456	18.334	24.032	30.662
FORT MCPHERSON	SNOW(71-)	COUNT	4	4	7	4	2	7	4	4	3	4	3	5
FORT MCPHERSON	SNOW(71-)	AVG	43.75	56.25	54.285	44.5	0	0	0	0	1.6666	12	28.666	41.6
FORT MCPHERSON	SNOW(71-)	STD_DEV	16.482	19.395	15.790	26.995	0	0	0	0	2.3570	8.4852	10.530	22.114
FORT MCPHERSON	PREP(ALL)	COUNT	52	51	52	50	47	51	55	51	49	50	51	50
FORT MCPHERSON	PREP(ALL)	AVG	187.69	170.72	192.94	203.92	133.40	259.45	283	403.74	296.59	383.42	272.66	199.82
FORT MCPHERSON	PREP(ALL)	STD_DEV	146.71	130.30	183.94	131.56	115.12	207.19	193.27	255.98	177.05	271.72	197.24	192.34
FORT MCPHERSON	PREP(-71)	COUNT	7	7	7	7	6	5	4	4	5	5	6	5
FORT MCPHERSON	PREP(-71)	AVG	212.57	185.14	131.42	217.42	127.83	390.8	322	478.25	273.2	333.6	324.33	176.8
FORT MCPHERSON	PREP(-71)	STD_DEV	92.229	181.84	90.838	110.61	104.29	265.52	119.30	162.77	155.02	128.74	180.38	69.430
FORT MCPHERSON	TEMP(ALL)	COUNT	63	62	62	61	61	57	51	51	57	62	65	59
FORT MCPHERSON	TEMP(ALL)	AVG	-29.80	-27.58	-22.06	-11.70	0.9606	11.424	14.835	11.670	3.6491	-7.585	-21.36	-26.56
FORT MCPHERSON	TEMP(ALL)	STD_DEV	4.4856	3.8393	3.2112	3.1711	2.1547	1.7301	1.3402	1.7555	2.1200	3.2847	4.0739	3.9514
FORT MCPHERSON	TEMP(-71)	COUNT	7	7	7	7	6	5	4	4	5	5	6	4
FORT MCPHERSON	TEMP(-71)	AVG	-29.51	-28.9	-24.02	-12.24	1.1666	11.42	15.225	11.45	4.44	-8.26	-21.31	-27.62
FORT MCPHERSON	TEMP(-71)	STD_DEV	4.2181	3.2984	1.9285	2.5353	0.8239	1.7451	0.8699	1.4221	1.9925	3.0571	3.8045	3.4499
FORT NORMAN	SNOW(ALL)	COUNT	13	11	11	13	12	10	11	12	10	9	10	8
FORT NORMAN	SNOW(ALL)	AVG	46.153	53.454	48.818	34.230	0	0	0	0	1.9	12.111	33.2	34
FORT NORMAN	SNOW(ALL)	STD_DEV	24.140	12.823	23.103	31.990	0	0	0	0	2.8627	15.870	16.957	7.3654
FORT NORMAN	SNOW(71-)	COUNT	0	0	1	1	3	4	5	6	1	0	0	0
FORT NORMAN	SNOW(71-)	AVG	ERR	ERR	33	0	0	0	0	0	0	ERR	ERR	ERR
FORT NORMAN	SNOW(71-)	STD_DEV	ERR	ERR	0	0	0	0	0	0	0	ERR	ERR	ERR
FORT NORMAN	PREP(ALL)	COUNT	53	54	53	51	51	49	52	52	49	53	51	47
FORT NORMAN	PREP(ALL)	AVG	130.18	120.87	117.28	140.09	221.25	376.69	482.75	526.55	370.85	263.83	220.82	122.87
FORT NORMAN	PREP(ALL)	STD_DEV	81.087	93.891	122.82	108.88	159.67	206.38	250.07	327.02	254.69	225.05	186.69	96.834
FORT NORMAN	PREP(-71)	COUNT	3	4	4	3	1	1	4	4	0	3	4	0
FORT NORMAN	PREP(-71)	AVG	188	198	102.5	233	150	.442	311.5	600.75	ERR	366.33	236.25	ERR
FORT NORMAN	PREP(-71)	STD_DEV	9.8994	70.210	49.987	40.472	0	0	159.40	265.66	ERR	62.376	144.07	ERR
FORT NORMAN	TEMP(ALL)	COUNT	49	51	49	50	50	48	48	50	47	50	51	48
FORT NORMAN	TEMP(ALL)	AVG	-27.86	-25.12	-16.78	-7.408	4.984	12.878	15.508	12.5	5.8787	-4.066	-18.24	-26.09
FORT NORMAN	TEMP(ALL)	STD_DEV	3.8633	3.9374	3.1553	2.9176	1.7016	1.7558	1.3550	1.7249	1.9681	2.3666	3.4789	3.5439
FORT NORMAN	TEMP(-71)	COUNT	3	4	4	4	2	1	4	4	1	3	4	0

FORT NORMAN	TEMP(-71)	AVG	-22.86	-25.62	-18.17	-7.925	5.65	15.4	16.825	12.525	8.5	-5.766	-20.35	ERR
FORT NORMAN	TEMP(-71)	STD_DEV	3.7034	3.6751	1.9149	3.8199	1.35	0	0.9065	0.6977	0	1.5456	4.0109	ERR
FORT PROVIDENCE	SNOW(ALL)	COUNT	20	23	24	24	25	25	26	24	24	24	23	19
FORT PROVIDENCE	SNOW(ALL)	AVG	47.25	52.347	53.25	11.375	0	0	0	0	0.3333	3.2083	18.478	32.368
FORT PROVIDENCE	SNOW(ALL)	STD_DEV	19.452	22.229	26.694	15.582	0	0	0	0	1.5986	5.8308	14.175	21.558
FORT PROVIDENCE	SNOW(71-)	COUNT	4	7	8	8	9	10	10	9	9	10	8	5
FORT PROVIDENCE	SNOW(71-)	AVG	38.5	51.285	44.875	5.375	0	0	0	0	0	3.6	24	34.8
FORT PROVIDENCE	SNOW(71-)	STD_DEV	9.0691	15.134	11.151	9.3399	0	0	0	0	0	6.2481	13.784	13.377
FORT PROVIDENCE	PREP(ALL)	COUNT	22	28	29	29	29	29	28	27	27	27	28	26
FORT PROVIDENCE	PREP(ALL)	AVG	182.13	152.92	151.82	164.31	179.89	246.58	373.07	335.59	264.70	214.33	254.67	218.26
FORT PROVIDENCE	PREP(ALL)	STD_DEV	106.47	90.177	104.53	115.28	150.41	193.18	204.79	231.02	142.40	151.72	160.41	113.23
FORT PROVIDENCE	PREP(-71)	COUNT	4	10	10	10	10	10	10	9	9	9	10	7
FORT PROVIDENCE	PREP(-71)	AVG	261	186.4	151.4	199.2	218.6	283.2	420	323.55	261	196.11	285.2	255.28
FORT PROVIDENCE	PREP(-71)	STD_DEV	78.800	106.95	94.432	136.68	136.63	169.13	178.35	140.28	114.18	196.77	172.25	121.06
FORT PROVIDENCE	TEMP(ALL)	COUNT	21	25	29	29	29	29	28	27	27	27	28	24
FORT PROVIDENCE	TEMP(ALL)	AVG	-26.71	-23.2	-15.58	-3.886	6.8689	12.910	16.2	14.344	8.2555	-0.311	-12.67	-22.67
FORT PROVIDENCE	TEMP(ALL)	STD_DEV	3.5426	3.6471	2.9812	4.0315	1.9449	1.3879	1.1628	1.6665	1.4810	1.9535	3.9285	4.2584
FORT PROVIDENCE	TEMP(-71)	COUNT	4	8	10	10	10	10	10	9	9	9	10	5
FORT PROVIDENCE	TEMP(-71)	AVG	-26.4	-20.9	-15.96	-2.11	7.79	13.19	16.15	13.7	8.3666	-0.1	-12.74	-21.84
FORT PROVIDENCE	TEMP(-71)	STD_DEV	3.4168	4.2898	3.0239	3.4924	2.1224	0.7595	1.4786	1.4399	1.6418	1.8926	3.8144	2.2177
FORT RESOLUTION	SNOW(ALL)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT RESOLUTION	SNOW(ALL)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT RESOLUTION	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	PREP(ALL)	COUNT	19	21	16	18	19	23	25	22	25	24	23	21
FORT RESOLUTION	PREP(ALL)	AVG	165.68	129	134.68	89.277	249.05	300.04	281.68	351.90	363.64	288.20	335.82	158.71
FORT RESOLUTION	PREP(ALL)	STD_DEV	121.38	182.53	107.65	63.144	164.91	245.52	226.96	197.37	197.27	195.05	232.55	101.29
FORT RESOLUTION	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT RESOLUTION	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	TEMP(ALL)	COUNT	20	20	17	22	24	24	24	22	25	23	20	22
FORT RESOLUTION	TEMP(ALL)	AVG	-28.24	-24.24	-19.35	-6.118	4.8708	11.412	15.7	13.945	7.188	-0.517	-12.85	-22.98
FORT RESOLUTION	TEMP(ALL)	STD_DEV	3.9785	5.1158	3.8449	3.7938	2.0957	1.9477	1.4927	1.7489	1.6282	2.8355	4.2145	4.1264
FORT RESOLUTION	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT RESOLUTION	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT RESOLUTION A	SNOW(ALL)	COUNT	32	32	31	32	36	39	38	37	35	28	30	29
FORT RESOLUTION A	SNOW(ALL)	AVG	50.531	55.906	51.290	11.281	0	0	0	0	0.5142	7.7142	33.933	43.241
FORT RESOLUTION A	SNOW(ALL)	STD_DEV	15.662	18.407	21.473	15.746	0	0	0	0	1.8878	10.888	16.014	12.037
FORT RESOLUTION A	SNOW(71-)	COUNT	8	8	7	8	12	15	14	13	12	5	6	5
FORT RESOLUTION A	SNOW(71-)	AVG	47.625	47.625	38	4.875	0	0	0	0	0.8333	14.2	27.166	36.8
FORT RESOLUTION A	SNOW(71-)	STD_DEV	11.466	16.286	10.267	6.3725	0	0	0	0	2.7638	8.6579	11.186	11.6
FORT RESOLUTION A	PREP(ALL)	COUNT	43	45	44	44	46	47	43	44	45	45	46	43
FORT RESOLUTION A	PREP(ALL)	AVG	182.86	135.44	120.31	128.18	164.67	244.72	373.32	337.22	374.84	355.8	416.91	196.06
FORT RESOLUTION A	PREP(ALL)	STD_DEV	100.88	102.39	94.348	112.12	133.37	175.03	206.88	223.61	200.18	206.21	159.36	118.79
FORT RESOLUTION A	PREP(-71)	COUNT	9	12	11	11	13	14	11	10	12	10	11	9
FORT RESOLUTION A	PREP(-71)	AVG	207.11	142.16	106.09	127.63	141.07	212.71	417.54	371.4	309.66	412.3	338.54	153.88
FORT RESOLUTION A	PREP(-71)	STD_DEV	90.248	141.71	57.496	126.45	103.91	139.22	374.87	212.37	120.68	221.46	166.30	86.682
FORT RESOLUTION A	TEMP(ALL)	COUNT	46	47	44	46	45	47	44	45	46	46	46	43
FORT RESOLUTION A	TEMP(ALL)	AVG	-25.95	-23.11	-16.91	-5.008	5.7377	12.155	15.852	14.008	7.3260	-0.039	-11	-21.49
FORT RESOLUTION A	TEMP(ALL)	STD_DEV	4.0944	4.5928	3.5297	3.7951	2.0669	1.8657	1.3260	1.8483	1.6334	2.1612	3.3933	3.9381
FORT RESOLUTION A	TEMP(-71)	COUNT	12	14	11	13	12	14	11	11	13	11	12	10
FORT RESOLUTION A	TEMP(-71)	AVG	-24.59	-22.29	-16.24	-3.484	6.8	12.757	15.427	13.472	7.0461	-0.336	-10.69	-22.51
FORT RESOLUTION A	TEMP(-71)	STD_DEV	4.4456	4.7805	3.4166	3.5254	2.7991	1.1890	1.4845	1.7352	1.6855	2.0132	3.6513	2.7854
FORT SIMPSON	SNOW(ALL)	COUNT	17	17	17	17	16	17	17	17	16	15	16	16
FORT SIMPSON	SNOW(ALL)	AVG	51.352	80.058	62.823	14	0	0	0	0	0.5	7.9333	24.375	39.5

FORT SIMPSON	SNOW(ALL)	STD_DEV	19.736	21.341	26.268	16.338	0	0	0	0	1.3693	6.8941	13.587	14.937
FORT SIMPSON	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON	PREP(ALL)	COUNT	62	61	62	64	62	62	57	62	62	64	61	60
FORT SIMPSON	PREP(ALL)	AVG	172.54	143.63	148.43	188.01	296.12	388.30	485.26	410.46	342.53	247.54	227.54	207.48
FORT SIMPSON	PREP(ALL)	STD_DEV	143.02	105.34	103.96	216.55	207.87	272.39	329.85	253.61	234.13	195.32	130.52	148.90
FORT SIMPSON	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON	TEMP(ALL)	COUNT	57	57	58	59	57	58	57	60	60	61	58	58
FORT SIMPSON	TEMP(ALL)	AVG	-27.17	-23.55	-16.35	-3.383	7.3385	13.727	16.577	14.31	7.77	-1.803	-14.96	-24.43
FORT SIMPSON	TEMP(ALL)	STD_DEV	3.6299	4.1128	3.2432	3.2552	1.9278	1.4482	1.0881	1.4781	1.8407	2.5504	3.7087	3.8599
FORT SIMPSON	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON A	SNOW(ALL)	COUNT	24	24	24	24	24	24	24	24	24	24	24	25
FORT SIMPSON A	SNOW(ALL)	AVG	46.166	54.625	53.458	13.166	0	0	0	0	0.7083	11.375	27.833	37.36
FORT SIMPSON A	SNOW(ALL)	STD_DEV	13.655	14.854	19.587	17.220	0	0	0	0	2.0099	11.048	11.887	13.148
FORT SIMPSON A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	16	17
FORT SIMPSON A	SNOW(71-)	AVG	45.470	54.235	55	9.3529	0	0	0	0	1	12.411	27.625	38
FORT SIMPSON A	SNOW(71-)	STD_DEV	14.633	15.302	20.358	14.572	0	0	0	0	2.3263	12.414	12.144	15.159
FORT SIMPSON A	PREP(ALL)	COUNT	24	24	24	24	24	24	24	24	24	24	25	25
FORT SIMPSON A	PREP(ALL)	AVG	198.29	187.37	185.12	176.37	281.16	388.70	517.70	477.54	305.20	357.83	244.2	190.96
FORT SIMPSON A	PREP(ALL)	STD_DEV	97.458	125.97	118.66	133.85	230.39	239.32	285.70	276.25	196.70	280.98	123.22	80.083
FORT SIMPSON A	PREP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
FORT SIMPSON A	PREP(-71)	AVG	212.82	199.23	196.11	171.11	257.35	391.11	534.05	520.88	281.47	399.11	225.52	199.23
FORT SIMPSON A	PREP(-71)	STD_DEV	106.82	140.76	128.86	137.54	215.37	263.82	311.49	282.41	216.27	317.54	110.78	88.829
FORT SIMPSON A	TEMP(ALL)	COUNT	24	24	24	24	24	24	24	24	24	24	25	25
FORT SIMPSON A	TEMP(ALL)	AVG	-26.67	-22.24	-14.59	-1.7	8.5208	14.687	16.733	14.041	7.4541	-1.916	-16.02	-23.97
FORT SIMPSON A	TEMP(ALL)	STD_DEV	5.4617	4.5189	3.3218	3.1966	1.8179	0.9202	1.2012	1.3092	2.0552	2.1505	3.8113	3.8815
FORT SIMPSON A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
FORT SIMPSON A	TEMP(-71)	AVG	-25.27	-22.07	-14.60	-1.358	8.8176	14.905	16.941	14.058	7.8294	-2.076	-15.86	-24.16
FORT SIMPSON A	TEMP(-71)	STD_DEV	5.3864	4.7192	2.7592	3.2599	2.0393	0.8192	1.2146	1.3043	2.0186	2.2537	3.9414	3.9166
FORT SIMPSON CDA	SNOW(ALL)	COUNT	8	8	8	9	8	8	8	8	8	9	9	9
FORT SIMPSON CDA	SNOW(ALL)	AVG	33.125	37.875	40.5	11	0	0	0	0	0	6.1111	17	24.111
FORT SIMPSON CDA	SNOW(ALL)	STD_DEV	6.3331	9.0614	7.3143	14.929	0	0	0	0	0	4.2017	5.4569	3.9283
FORT SIMPSON CDA	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON CDA	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON CDA	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON CDA	PREP(ALL)	COUNT	8	8	8	9	9	9	9	9	9	9	9	9
FORT SIMPSON CDA	PREP(ALL)	AVG	186.5	170.75	157.75	181.22	241.88	471	415.33	435.88	324.11	277.11	251.88	192.22
FORT SIMPSON CDA	PREP(ALL)	STD_DEV	133.00	81.120	80.806	105.25	202.98	208.43	202.88	249.57	112.48	113.27	115.42	71.934
FORT SIMPSON CDA	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON CDA	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON CDA	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON CDA	TEMP(ALL)	COUNT	8	8	8	9	9	9	9	9	9	9	9	9
FORT SIMPSON CDA	TEMP(ALL)	AVG	-29.37	-22.97	-15.4	-3.311	7.4555	14.733	17.077	14.722	7.1444	-0.744	-15.65	-23.5
FORT SIMPSON CDA	TEMP(ALL)	STD_DEV	4.0366	3.3722	4.2449	3.3811	1.2815	1.1097	0.9952	1.2587	1.5195	1.9720	2.4848	3.883C
FORT SIMPSON CDA	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SIMPSON CDA	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SIMPSON CDA	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	SNOW(ALL)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SMITH	SNOW(ALL)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SMITH	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR

FORT SMITH	PREP(ALL)	COUNT	16	17	16	18	17	18	18	17	16	16	16	16
FORT SMITH	PREP(ALL)	AVG	143.43	181.58	225.75	142.94	283.76	321.55	600.11	425.41	428.62	255.93	248.87	254.75
FORT SMITH	PREP(ALL)	STD_DEV	93.343	180.09	130.73	114.63	134.86	252.03	312.36	330.82	324.06	151.81	187.50	163.94
FORT SMITH	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SMITH	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	TEMP(ALL)	COUNT	16	17	16	18	18	18	17	17	15	14	15	15
FORT SMITH	TEMP(ALL)	AVG	-24.74	-21.55	-14.53	-2.777	7.7888	13.286	16.417	13.982	7.7933	0.85	-11.22	-19.81
FORT SMITH	TEMP(ALL)	STD_DEV	4.8912	5.6924	3.3551	4.1540	1.3839	1.5804	1.1833	1.8334	2.3219	2.9587	3.6977	5.1389
FORT SMITH	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
FORT SMITH	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
FORT SMITH A	SNOW(ALL)	COUNT	41	41	40	40	41	41	41	41	40	39	41	40
FORT SMITH A	SNOW(ALL)	AVG	45.609	50.487	42.125	3.975	0	0	0	0	0.275	4.7179	20.146	32.15
FORT SMITH A	SNOW(ALL)	STD_DEV	14.060	14.347	17.029	8.0108	0	0	0	0	1.3226	6.1808	9.4108	10.778
FORT SMITH A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	16	17	17
FORT SMITH A	SNOW(71-)	AVG	46.647	50.176	43.058	1.6470	0	0	0	0	0.1764	5.6875	20.294	33.705
FORT SMITH A	SNOW(71-)	STD_DEV	10.802	10.782	13.822	3.7564	0	0	0	0	0.7058	6.7612	10.051	7.1023
FORT SMITH A	PREP(ALL)	COUNT	43	44	44	43	44	44	44	44	45	45	43	43
FORT SMITH A	PREP(ALL)	AVG	185.81	150.38	139.65	157.81	261.93	389.61	541.88	425.52	378.11	287.2	254.69	220.13
FORT SMITH A	PREP(ALL)	STD_DEV	91.902	72.987	72.345	97.852	170.86	286.97	307.47	233.54	154.18	172.67	125.60	101.79
FORT SMITH A	PREP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
FORT SMITH A	PREP(-71)	AVG	201	144.76	132.58	129.47	286.11	473.82	565.41	499.47	383	289	220.58	201.82
FORT SMITH A	PREP(-71)	STD_DEV	85.727	84.985	69.736	105.71	171.28	298.31	331.22	281.03	190.37	212.19	102.11	80.043
FORT SMITH A	TEMP(ALL)	COUNT	42	44	44	44	44	44	44	44	45	45	44	44
FORT SMITH A	TEMP(ALL)	AVG	-25.88	-21.91	-14.12	-2.197	7.7568	13.452	16.075	14.161	7.7	0.4111	-11.79	-21.52
FORT SMITH A	TEMP(ALL)	STD_DEV	4.7619	4.2592	3.4870	4.1189	1.9925	1.5187	1.0361	1.6326	1.6581	2.1349	3.8503	4.4198
FORT SMITH A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
FORT SMITH A	TEMP(-71)	AVG	-24.27	-20.77	-13.37	-0.547	8.8176	13.982	16.152	13.976	7.7294	0.2529	-11.58	-21.7
FORT SMITH A	TEMP(-71)	STD_DEV	5.3293	5.1104	2.8339	3.3194	2.0762	0.9500	1.2190	1.9246	1.8645	1.7595	3.9898	4.5453
HAY LAKES RS	SNOW(ALL)	COUNT	1	0	1	1	3	3	3	3	1	1	1	1
HAY LAKES RS	SNOW(ALL)	AVG	28	ERR	85	0	0	0	0	0	0	5	10	33
HAY LAKES RS	SNOW(ALL)	STD_DEV	0	ERR	0	0	0	0	0	0	0	0	0	0
HAY LAKES RS	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HAY LAKES RS	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY LAKES RS	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY LAKES RS	PREP(ALL)	COUNT	2	1	1	1	3	3	3	3	1	1	2	2
HAY LAKES RS	PREP(ALL)	AVG	188	368	548	447	261	169.66	803.33	273.33	277	312	307.5	176.5
HAY LAKES RS	PREP(ALL)	STD_DEV	124	0	0	0	237.59	48.127	279.86	267.26	0	0	114.5	8.5
HAY LAKES RS	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HAY LAKES RS	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY LAKES RS	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY LAKES RS	TEMP(ALL)	COUNT	2	1	1	1	2	3	3	3	1	1	2	2
HAY LAKES RS	TEMP(ALL)	AVG	-29.1	-18.3	-10.2	2.7	9.2	13.866	15.333	13.866	7.1	-1.5	-11.65	-18.85
HAY LAKES RS	TEMP(ALL)	STD_DEV	4.3	0	0	0	0.1	0.3299	1.0274	1.6996	0	0	0.55	6.95
HAY LAKES RS	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HAY LAKES RS	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY LAKES RS	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HAY RIVER A	SNOW(ALL)	COUNT	40	41	41	40	41	41	41	41	40	40	41	41
HAY RIVER A	SNOW(ALL)	AVG	46.15	53.634	45.487	8.025	0	0	0	0	0.775	5.1	23.292	34.902
HAY RIVER A	SNOW(ALL)	STD_DEV	22.945	22.959	22.963	11.718	0	0	0	0	2.9957	8.8198	15.433	19.255
HAY RIVER A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
HAY RIVER A	SNOW(71-)	AVG	36.882	44.823	42.529	8.4705	0	0	0	0	0.5882	4.3529	18.588	29.529
HAY RIVER A	SNOW(71-)	STD_DEV	12.023	14.341	20.009	10.404	0	0	0	0	1.6109	5.9501	10.426	12.668
HAY RIVER A	PREP(ALL)	COUNT	43	44	44	45	45	44	44	44	44	44	44	45
HAY RIVER A	PREP(ALL)	AVG	201.48	175.83	159.29	154.77	190.73	291.65	444.86	401.63	401.68	330.02	339.81	220.31
HAY RIVER A	PREP(ALL)	STD_DEV	117.91	104.77	89.966	138.83	134.53	207.20	273.48	246.76	206.73	206.15	222.98	113.97
HAY RIVER A	PREP(-71)	COUNT	16	17	17	17	17	17	17	17	17	17	17	17

HAY RIVER A	PREP(-71)	AVG	182.82	161.70	144.70	128.82	236.76	337.58	392.70	498.64	356.41	303.56	243.88	183.05
HAY RIVER A	PREP(-71)	STD_DEV	79.344	81.287	88.096	122.37	118.94	242.74	242.93	250.18	159.19	185.89	117.18	67.818
HAY RIVER A	TEMP(ALL)	COUNT	44	44	43	45	43	44	44	44	44	44	44	45
HAY RIVER A	TEMP(ALL)	AVG	-24.54	-21.88	-15.77	-4.171	5.6209	11.797	15.652	14.302	8.2295	0.9045	-11.52	-20.72
HAY RIVER A	TEMP(ALL)	STD_DEV	4.9236	4.3509	3.2851	4.0131	2.2794	1.5146	0.9928	1.5562	1.8750	1.9593	4.0668	4.3680
HAY RIVER A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
HAY RIVER A	TEMP(-71)	AVG	-23.04	-20.99	-15.87	-2.829	6.5588	12.447	15.747	14.129	8.3529	0.7647	-11.8	-20.82
HAY RIVER A	TEMP(-71)	STD_DEV	5.5255	5.2287	2.7197	3.7810	2.5181	0.7585	1.2083	1.5862	1.9372	1.7105	4.1817	4.2463
HAY R P'SE G'NS	SNOW(ALL)	COUNT	0	0	0	7	18	22	23	21	21	8	0	0
HAY R P'SE G'NS	SNOW(ALL)	AVG	ERR	ERR	ERR	0	0	0	0	0	0	1.25	ERR	ERR
HAY R P'SE G'NS	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	0	0	0	0	0	0	3.3071	ERR	ERR
HAY R P'SE G'NS	SNOW(71-)	COUNT	0	0	0	5	10	16	17	15	16	5	0	0
HAY R P'SE G'NS	SNOW(71-)	AVG	ERR	ERR	ERR	0	0	0	0	0	0	2	ERR	ERR
HAY R P'SE G'NS	SNOW(71-)	STD_DEV	ERR	ERR	ERR	0	0	0	0	0	0	4	ERR	ERR
HAY R P'SE G'NS	PREP(ALL)	COUNT	22	22	22	16	20	22	23	21	22	16	19	23
HAY R P'SE G'NS	PREP(ALL)	AVG	200.86	180.22	175.40	200.18	299.85	452.04	481.78	528.66	344.81	198.25	287.89	184.86
HAY R P'SE G'NS	PREP(ALL)	STD_DEV	119.16	111.33	96.766	227.73	181.51	301.61	218.74	283.14	150.61	120.31	139.35	95.461
HAY R P'SE G'NS	PREP(-71)	COUNT	17	17	17	11	15	16	17	15	17	10	13	17
HAY R P'SE G'NS	PREP(-71)	AVG	193.58	184.47	166.23	140.63	336.73	447.75	430.29	604.66	352.41	207	305.30	199
HAY R P'SE G'NS	PREP(-71)	STD_DEV	117.67	120.82	105.38	191.41	188.85	299.73	166.69	277.44	158.85	106.67	144.44	85.811
HAY R P'SE G'NS	TEMP(ALL)	COUNT	22	21	22	17	20	22	23	21	22	15	19	23
HAY R P'SE G'NS	TEMP(ALL)	AVG	-25.73	-22.33	-15.53	-2.917	7.635	13.468	15.969	13.933	7.5181	0.0266	-13.68	-22.06
HAY R P'SE G'NS	TEMP(ALL)	STD_DEV	6.0939	4.4476	3.0906	3.6776	2.1939	0.9654	1.1599	1.3932	2.0245	1.3527	4.7396	4.4276
HAY R P'SE G'NS	TEMP(-71)	COUNT	17	16	17	12	15	16	17	15	17	9	13	17
HAY R P'SE G'NS	TEMP(-71)	AVG	-24.28	-22.48	-15.61	-2.183	7.9	13.743	16.058	13.886	7.8117	0.0888	-13.58	-22.4
HAY R P'SE G'NS	TEMP(-71)	STD_DEV	5.9292	4.9799	2.9531	3.5713	2.4066	0.6882	1.2146	1.5348	1.9987	1.5379	5.1124	4.5131
HERSCHEL ISLAND	SNOW(ALL)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HERSCHEL ISLAND	SNOW(ALL)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HERSCHEL ISLAND	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	PREP(ALL)	COUNT	0	0	0	0	3	3	4	4	5	4	2	2
HERSCHEL ISLAND	PREP(ALL)	AVG	ERR	ERR	ERR	ERR	132	199	188	283.5	105.6	149.75	67	68.5
HERSCHEL ISLAND	PREP(ALL)	STD_DEV	ERR	ERR	ERR	ERR	24.832	212.64	33.933	242.29	44.741	104.39	47	17.5
HERSCHEL ISLAND	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HERSCHEL ISLAND	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	TEMP(ALL)	COUNT	10	10	10	8	7	8	8	9	8	9	10	11
HERSCHEL ISLAND	TEMP(ALL)	AVG	-26.49	-24.21	-22.12	-16.97	-7	2.4625	6.625	5.2111	0.1	-9.077	-20.68	-24.85
HERSCHEL ISLAND	TEMP(ALL)	STD_DEV	7.5600	4.6892	6.0200	1.0650	1.4696	1.2786	1.2437	1.0918	2.3774	3.3802	2.9785	4.4864
HERSCHEL ISLAND	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HERSCHEL ISLAND	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HERSCHEL ISLAND	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	SNOW(ALL)	COUNT	3	3	3	3	3	4	4	4	4	3	3	3
HIGH LEVEL A	SNOW(ALL)	AVG	38.333	42.666	27	0	0	0	0	0	0	1.6666	16	25.333
HIGH LEVEL A	SNOW(ALL)	STD_DEV	3.2998	6.2360	19.798	0	0	0	0	0	0	2.3570	7.8740	3.2998
HIGH LEVEL A	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HIGH LEVEL A	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	PREP(ALL)	COUNT	3	3	3	3	3	3	4	4	4	3	3	3
HIGH LEVEL A	PREP(ALL)	AVG	178.66	182.66	202.33	287	270	337	769.75	498	331.25	255.66	289.66	173.33
HIGH LEVEL A	PREP(ALL)	STD_DEV	47.709	10.842	59.488	221.72	169.97	133.98	509.78	253.73	156.55	128.26	38.421	54.707
HIGH LEVEL A	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HIGH LEVEL A	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	TEMP(ALL)	COUNT	3	3	3	3	3	3	4	4	4	3	3	3
HIGH LEVEL A	TEMP(ALL)	AVG	-27.7	-16.33	-8.166	2.4	8.8333	13.466	15.05	13.775	8.15	1.1	-10.1	-18.4

HIGH LEVEL A	TEMP(ALL)	STD_DEV	3.7478	1.5755	1.9567	1.0677	0.1247	0.9463	0.9233	1.4254	1.4840	0.9933	1.6309	5.2706
HIGH LEVEL A	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
HIGH LEVEL A	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
HIGH LEVEL A	SNOW(ALL)	COUNT	17	17	17	17	17	17	17	16	17	17	17	18
HIGH LEVEL A	SNOW(ALL)	AVG	43.588	49.941	33.470	0.5294	0	0	0	0	0	5.1764	21.176	33.777
HIGH LEVEL A	SNOW(ALL)	STD_DEV	13.164	18.646	22.260	1.4599	0	0	0	0	0	9.0243	11.556	15.002
HIGH LEVEL A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	16	17	16	16	17
HIGH LEVEL A	SNOW(71-)	AVG	43.588	49.941	33.470	0.5294	0	0	0	0	0	5.5	22.187	34.588
HIGH LEVEL A	SNOW(71-)	STD_DEV	13.164	18.646	22.260	1.4599	0	0	0	0	0	9.2059	11.159	15.049
HIGH LEVEL A	PREP(ALL)	COUNT	17	17	17	17	17	17	17	16	17	17	18	17
HIGH LEVEL A	PREP(ALL)	AVG	211.29	179.11	186.11	167.17	399	657.82	626.35	575.37	385.52	279.47	240.33	223.23
HIGH LEVEL A	PREP(ALL)	STD_DEV	76.955	102.45	141.95	122.33	189.23	297.31	236.85	308.29	212.88	232.12	151.55	112.65
HIGH LEVEL A	PREP(-71)	COUNT	17	17	17	17	17	17	17	16	17	17	17	16
HIGH LEVEL A	PREP(-71)	AVG	211.29	179.11	186.11	167.17	399	657.82	626.35	575.37	385.52	279.47	249.41	221.93
HIGH LEVEL A	PREP(-71)	STD_DEV	76.955	102.45	141.95	122.33	189.23	297.31	236.85	308.29	212.88	232.12	151.11	116.00
HIGH LEVEL A	TEMP(ALL)	COUNT	17	17	17	17	17	17	17	17	17	17	18	18
HIGH LEVEL A	TEMP(ALL)	AVG	-21.42	-17.88	-10.53	1.8647	9.7411	14.182	16.076	13.8	8.2470	1.2882	-11.77	-20.34
HIGH LEVEL A	TEMP(ALL)	STD_DEV	5.3575	4.9500	2.8392	2.8836	1.5266	0.6980	1.1248	1.5200	1.8198	1.6711	4.6035	4.4629
HIGH LEVEL A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
HIGH LEVEL A	TEMP(-71)	AVG	-21.42	-17.88	-10.53	1.8647	9.7411	14.182	16.076	13.8	8.2470	1.2882	-11.7	-20.21
HIGH LEVEL A	TEMP(-71)	STD_DEV	5.3575	4.9500	2.8392	2.8836	1.5266	0.6980	1.1248	1.5200	1.8198	1.6711	4.7271	4.5784
HIGH LEVEL RS	SNOW(ALL)	COUNT	1	2	1	3	7	5	6	7	6	5	1	1
HIGH LEVEL RS	SNOW(ALL)	AVG	81	60.5	94	1	0	0	0	0	0	5.2	41	74
HIGH LEVEL RS	SNOW(ALL)	STD_DEV	0	30.5	0	1.4142	0	0	0	0	0	6.3686	0	0
HIGH LEVEL RS	SNOW(71-)	COUNT	0	0	0	2	2	2	2	2	2	1	0	0
HIGH LEVEL RS	SNOW(71-)	AVG	ERR	ERR	ERR	0	0	0	0	0	0	0	ERR	ERR
HIGH LEVEL RS	SNOW(71-)	STD_DEV	ERR	ERR	ERR	0	0	0	0	0	0	0	ERR	ERR
HIGH LEVEL RS	PREP(ALL)	COUNT	3	3	3	3	6	5	7	7	7	5	3	3
HIGH LEVEL RS	PREP(ALL)	AVG	290.66	141.66	197.33	305.33	356	671.8	677.85	384.14	326.57	144.8	156	245.66
HIGH LEVEL RS	PREP(ALL)	STD_DEV	103.50	124.45	147.73	158.87	263.48	399.00	244.89	153.16	141.30	107.69	129.89	102.95
HIGH LEVEL RS	PREP(-71)	COUNT	1	1	1	2	2	2	2	2	2	1	1	1
HIGH LEVEL RS	PREP(-71)	AVG	376	13	406	204	689.5	732.5	422.5	390	434.5	13	0	297
HIGH LEVEL RS	PREP(-71)	STD_DEV	0	0	0	84	20.5	220.5	123.5	187	10.5	0	0	0
HIGH LEVEL RS	TEMP(ALL)	COUNT	3	3	3	3	6	5	7	7	7	3	3	3
HIGH LEVEL RS	TEMP(ALL)	AVG	-26.76	-19.73	-13.03	0.5666	9.0166	13.36	15.957	13.814	8.0714	2.2666	-14.53	-17.6
HIGH LEVEL RS	TEMP(ALL)	STD_DEV	4.1986	0.2867	2.8662	3.7862	1.1006	0.7631	1.2511	1.2310	1.8979	3.1094	5.6061	2.1226
HIGH LEVEL RS	TEMP(-71)	COUNT	1	1	1	2	2	2	2	2	2	0	1	1
HIGH LEVEL RS	TEMP(-71)	AVG	-23.6	-20.1	-13.4	3.1	8.8	13.85	16.1	12.85	9.35	ERR	-8.7	-14.6
HIGH LEVEL RS	TEMP(-71)	STD_DEV	0	0	0	1.5	1.6	0.05	1.5	1.05	0.05	ERR	0	0
HORN RIVER	SNOW(ALL)	COUNT	2	1	1	1	1	1	2	2	2	2	2	2
HORN RIVER	SNOW(ALL)	AVG	36.5	61	61	0	0	0	0	0	0	1.5	15.5	34
HORN RIVER	SNOW(ALL)	STD_DEV	11.5	0	0	0	0	0	0	0	0	1.5	2.5	4
HORN RIVER	SNOW(71-)	COUNT	2	1	1	1	1	1	2	2	2	2	2	2
HORN RIVER	SNOW(71-)	AVG	36.5	61	61	0	0	0	0	0	0	1.5	15.5	34
HORN RIVER	SNOW(71-)	STD_DEV	11.5	0	0	0	0	0	0	0	0	1.5	2.5	4
HORN RIVER	PREP(ALL)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
HORN RIVER	PREP(ALL)	AVG	298.5	460	267	84	97	470	422	426.5	292.5	180.5	209.5	437
HORN RIVER	PREP(ALL)	STD_DEV	6.5	0	0	0	0	0	0	15.5	124.5	142.5	39.5	127
HORN RIVER	PREP(-71)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
HORN RIVER	PREP(-71)	AVG	298.5	460	267	84	97	470	422	426.5	292.5	180.5	209.5	437
HORN RIVER	PREP(-71)	STD_DEV	6.5	0	0	0	0	0	0	15.5	124.5	142.5	39.5	127
HORN RIVER	TEMP(ALL)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
HORN RIVER	TEMP(ALL)	AVG	-29.3	-27.1	-21.8	-4	5.8	14.5	15.8	13.35	7.35	-2.15	-15.65	-23.55
HORN RIVER	TEMP(ALL)	STD_DEV	0.6	0	0	0	0	0	0	0.45	1.95	1.85	3.25	1.05
HORN RIVER	TEMP(-71)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
HORN RIVER	TEMP(-71)	AVG	-29.3	-27.1	-21.8	-4	5.8	14.5	15.8	13.35	7.35	-2.15	-15.65	-23.55
HORN RIVER	TEMP(-71)	STD_DEV	0.6	0	0	0	0	0	0	0.45	1.95	1.85	3.25	1.05

INUVIK A	SNOW(ALL)	COUNT	30	30	30	31	30	30	29	30	29	30	30	30
INUVIK A	SNOW(ALL)	AVG	54.4	58.133	62.633	51.548	3.3	0	0	0.0333	1.4482	21.433	32.6	44.3
INUVIK A	SNOW(ALL)	STD_DEV	16.843	13.994	15.540	19.504	11.705	0	0	0.1795	2.6338	13.674	15.114	14.828
INUVIK A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
INUVIK A	SNOW(71-)	AVG	52.588	57.176	61.117	48.117	1	0	0	0.0588	1.8823	21.411	35.764	42.411
INUVIK A	SNOW(71-)	STD_DEV	17.560	15.730	17.572	22.302	3.5146	0	0	0.2352	2.9878	15.628	17.817	17.385
INUVIK A	PREP(ALL)	COUNT	30	30	31	31	31	30	30	30	31	30	31	31
INUVIK A	PREP(ALL)	AVG	167.83	110.53	108.96	139.87	176.03	217.56	322.73	429.23	234.70	304.33	177.84	166.83
INUVIK A	PREP(ALL)	STD_DEV	109.93	55.098	70.271	106.44	142.89	158.01	192.82	289.23	129.72	138.16	79.178	79.233
INUVIK A	PREP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
INUVIK A	PREP(-71)	AVG	141.41	100.35	78.588	121.52	177.58	234.52	281.17	403.52	254.88	278.11	188.35	151.52
INUVIK A	PREP(-71)	STD_DEV	75.081	49.181	35.888	82.382	152.79	170.23	183.49	132.59	95.028	145.96	86.254	83.370
INUVIK A	TEMP(ALL)	COUNT	30	30	31	31	31	31	31	31	31	31	30	31
INUVIK A	TEMP(ALL)	AVG	-28.96	-28.79	-24.66	-14.48	-0.893	10.481	13.535	10.529	3.2709	-8.235	-21.14	-26.56
INUVIK A	TEMP(ALL)	STD_DEV	4.9000	4.0307	3.1852	3.2127	2.0418	1.7701	1.5128	2.0391	1.9144	2.9244	3.9323	3.6243
INUVIK A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
INUVIK A	TEMP(-71)	AVG	-27.54	-28.18	-24.72	-14.65	-0.911	10.835	13.852	10.447	3.7176	-8.429	-20.75	-26.25
INUVIK A	TEMP(-71)	STD_DEV	5.3975	3.9535	2.8874	2.8313	2.4996	1.7819	1.5963	1.8128	2.1066	3.0245	4.8585	3.4997
KOMAKUK BEACH A	SNOW(ALL)	COUNT	27	27	27	27	26	24	27	27	28	29	27	28
KOMAKUK BEACH A	SNOW(ALL)	AVG	22.148	25.111	26.037	23.037	7.7692	0	0	0.3333	4.2142	14.448	17	19.714
KOMAKUK BEACH A	SNOW(ALL)	STD_DEV	11.107	10.052	10.185	9.8148	5.2132	0	0	1.2472	6.4716	11.084	10.470	9.2383
KOMAKUK BEACH A	SNOW(71-)	COUNT	17	17	17	17	16	17	17	17	17	17	17	17
KOMAKUK BEACH A	SNOW(71-)	AVG	21.470	24.823	25.529	22.176	8.8875	0	0	0.3529	4.4705	15.764	18.176	20
KOMAKUK BEACH A	SNOW(71-)	STD_DEV	10.825	9.2432	10.094	8.6720	4.2970	0	0	1.4117	7.2527	12.877	11.495	10.588
KOMAKUK BEACH A	PREP(ALL)	COUNT	28	27	27	28	28	26	28	29	30	30	28	28
KOMAKUK BEACH A	PREP(ALL)	AVG	54.142	35.925	29.148	39.321	38.785	141.96	288.42	353.44	189.43	170.43	88.535	48.928
KOMAKUK BEACH A	PREP(ALL)	STD_DEV	45.823	31.923	26.953	36.825	38.783	144.46	215.89	221.96	133.75	126.27	92.517	47.868
KOMAKUK BEACH A	PREP(-71)	COUNT	17	17	17	17	17	15	16	17	17	17	17	17
KOMAKUK BEACH A	PREP(-71)	AVG	58.529	44.058	28.882	48.176	39.529	163	293.68	384	235.11	185.05	107.47	56.941
KOMAKUK BEACH A	PREP(-71)	STD_DEV	39.008	33.574	33.597	39.087	43.040	124.16	132.60	196.16	146.58	121.67	106.57	47.434
KOMAKUK BEACH A	TEMP(ALL)	COUNT	24	23	27	29	29	27	30	29	30	30	30	28
KOMAKUK BEACH A	TEMP(ALL)	AVG	-24.83	-26.95	-25.94	-18.51	-5.679	3.4703	7.4666	5.9275	0.8666	-9.476	-18.9	-23.30
KOMAKUK BEACH A	TEMP(ALL)	STD_DEV	4.8073	3.9334	2.8658	2.7310	1.8830	1.2709	1.8933	1.7294	1.8378	2.8054	3.5376	3.4903
KOMAKUK BEACH A	TEMP(-71)	COUNT	16	14	17	17	17	17	17	17	17	17	17	17
KOMAKUK BEACH A	TEMP(-71)	AVG	-24.24	-26.73	-26.42	-19.02	-5.982	3.8529	7.5411	6.1294	0.8352	-9.676	-18.95	-23.85
KOMAKUK BEACH A	TEMP(-71)	STD_DEV	4.7405	3.5396	2.6704	2.1623	1.9415	1.3469	1.4200	1.6480	2.0908	3.0573	3.9334	3.7543
LITTLE DOCTOR LAKE	SNOW(ALL)	COUNT	9	11	10	9	5	6	5	5	6	5	8	9
LITTLE DOCTOR LAKE	SNOW(ALL)	AVG	52.666	58.272	58.6	24.666	0	0	0	0	0	12.2	25.5	41.888
LITTLE DOCTOR LAKE	SNOW(ALL)	STD_DEV	24.711	22.531	32.509	17.397	0	0	0	0	0	14.945	13.711	30.704
LITTLE DOCTOR LAKE	SNOW(71-)	COUNT	9	11	10	9	5	6	5	5	6	5	8	9
LITTLE DOCTOR LAKE	SNOW(71-)	AVG	52.666	58.272	58.6	24.666	0	0	0	0	0	12.2	25.5	41.888
LITTLE DOCTOR LAKE	SNOW(71-)	STD_DEV	24.711	22.531	32.509	17.397	0	0	0	0	0	14.945	13.711	30.704
LITTLE DOCTOR LAKE	PREP(ALL)	COUNT	10	11	11	10	5	6	5	5	6	10	11	11
LITTLE DOCTOR LAKE	PREP(ALL)	AVG	248.8	209.18	314.36	232.6	408.4	643.33	901.8	889.2	283.5	474.9	327.27	238.36
LITTLE DOCTOR LAKE	PREP(ALL)	STD_DEV	122.27	110.11	179.72	117.26	389.53	383.32	115.85	342.48	239.27	380.08	233.28	103.97
LITTLE DOCTOR LAKE	PREP(-71)	COUNT	10	11	11	10	5	6	5	5	6	10	11	11
LITTLE DOCTOR LAKE	PREP(-71)	AVG	248.8	209.18	314.36	232.6	408.4	643.33	901.8	889.2	283.5	474.9	327.27	238.36
LITTLE DOCTOR LAKE	PREP(-71)	STD_DEV	122.27	110.11	179.72	117.26	389.53	383.32	115.85	342.48	239.27	380.08	233.28	103.97
LITTLE DOCTOR LAKE	TEMP(ALL)	COUNT	10	11	11	10	5	6	5	5	6	10	11	11
LITTLE DOCTOR LAKE	TEMP(ALL)	AVG	-25.59	-22.78	-15.29	-2.91	6.8	13.566	15.42	12.78	7.5333	-2.37	-14.24	-25.28
LITTLE DOCTOR LAKE	TEMP(ALL)	STD_DEV	5.0577	4.7212	3.2570	2.8662	1.1454	0.8556	1.4634	0.8818	1.8719	2.9940	5.8080	3.1077
LITTLE DOCTOR LAKE	TEMP(-71)	COUNT	10	11	11	10	5	6	5	5	6	10	11	11
LITTLE DOCTOR LAKE	TEMP(-71)	AVG	-25.59	-22.78	-15.29	-2.91	6.8	13.566	15.42	12.78	7.5333	-2.37	-14.24	-25.28
LITTLE DOCTOR LAKE	TEMP(-71)	STD_DEV	5.0577	4.7212	3.2570	2.8662	1.1454	0.8556	1.4634	0.8818	1.8719	2.9940	5.8080	3.1077
MAHANNI VALLEY	SNOW(ALL)	COUNT	10	10	10	8	2	1	1	1	3	5	9	11
MAHANNI VALLEY	SNOW(ALL)	AVG	27.8	36.5	25.9	0.5	0	0	0	0	0	8	19.111	28.363
MAHANNI VALLEY	SNOW(ALL)	STD_DEV	16.448	18.782	14.186	0.8660	0	0	0	0	0	7.4833	8.8723	15.411
MAHANNI VALLEY	SNOW(71-)	COUNT	10	10	10	8	2	1	1	1	3	5	9	11

NAHANNI VALLEY	SNOW(71-)	AVG	27.8	36.5	25.9	0.5	0	0	0	0	0	8	19.111	28.383
NAHANNI VALLEY	SNOW(71-)	STD_DEV	16.448	18.762	14.166	0.8660	0	0	0	0	0	7.4833	8.6723	15.411
NAHANNI VALLEY	PREP(ALL)	COUNT	12	12	12	11	2	1	2	1	3	10	12	13
NAHANNI VALLEY	PREP(ALL)	AVG	226.08	264.5	222.08	141.27	442	1262	738.5	997	463.66	278.6	250.91	291.61
NAHANNI VALLEY	PREP(ALL)	STD_DEV	100.38	126.69	119.27	98.697	81	0	509.5	0	285.91	194.06	137.56	112.63
NAHANNI VALLEY	PREP(-71)	COUNT	12	12	12	11	2	1	2	1	3	10	12	13
NAHANNI VALLEY	PREP(-71)	AVG	226.08	264.5	222.08	141.27	442	1262	738.5	997	463.66	278.6	250.91	291.61
NAHANNI VALLEY	PREP(-71)	STD_DEV	100.38	126.69	119.27	98.697	81	0	509.5	0	285.91	194.06	137.56	112.63
NAHANNI VALLEY	TEMP(ALL)	COUNT	12	12	12	11	2	2	2	1	3	10	12	13
NAHANNI VALLEY	TEMP(ALL)	AVG	-23.24	-20.73	-12.58	0.4545	8.6	13.15	14.85	14.6	9.1333	-0.95	-14.84	-22.82
NAHANNI VALLEY	TEMP(ALL)	STD_DEV	6.5418	5.0113	3.1703	2.8757	0	0.45	0.45	0	1.0873	2.1039	4.8573	5.0783
NAHANNI VALLEY	TEMP(-71)	COUNT	12	12	12	11	2	2	2	1	3	10	12	13
NAHANNI VALLEY	TEMP(-71)	AVG	-23.24	-20.73	-12.58	0.4545	8.6	13.15	14.85	14.6	9.1333	-0.95	-14.84	-22.82
NAHANNI VALLEY	TEMP(-71)	STD_DEV	6.5418	5.0113	3.1703	2.8757	0	0.45	0.45	0	1.0873	2.1039	4.8573	5.0783
NORMAN WELLS A	SNOW(ALL)	COUNT	41	41	41	41	41	41	41	40	41	39	41	41
NORMAN WELLS A	SNOW(ALL)	AVG	50.609	59.219	59.146	23.048	0	0	0	0.05	0.4878	13.641	25.463	38.560
NORMAN WELLS A	SNOW(ALL)	STD_DEV	24.293	31.305	33.401	23.308	0	0	0	0.3122	1.2901	11.579	12.382	17.674
NORMAN WELLS A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	16	17	16	17	17
NORMAN WELLS A	SNOW(71-)	AVG	38.117	39.529	38.588	14.294	0	0	0	0.125	0.6470	10.437	19.941	28.823
NORMAN WELLS A	SNOW(71-)	STD_DEV	20.736	22.544	24.100	20.947	0	0	0	0.4841	1.8066	6.5866	7.5962	12.442
NORMAN WELLS A	PREP(ALL)	COUNT	44	44	44	44	44	45	45	44	45	45	45	45
NORMAN WELLS A	PREP(ALL)	AVG	189.52	153.02	116.45	145.52	179.79	379.68	504.15	565.45	313	275.37	196.97	164.69
NORMAN WELLS A	PREP(ALL)	STD_DEV	136.50	119.27	74.590	122.05	120.92	194.66	293.26	309.83	162.23	154.60	108.15	92.824
NORMAN WELLS A	PREP(-71)	COUNT	17	17	17	17	17	17	17	16	17	17	17	17
NORMAN WELLS A	PREP(-71)	AVG	159.52	121.82	104	152.35	225.05	403.29	412.17	474.25	272.52	315.52	163.58	172.94
NORMAN WELLS A	PREP(-71)	STD_DEV	80.462	74.265	53.445	130.80	138.27	225.81	211.92	293.54	110.23	178.68	57.879	83.311
NORMAN WELLS A	TEMP(ALL)	COUNT	44	44	44	44	45	45	45	45	45	45	45	45
NORMAN WELLS A	TEMP(ALL)	AVG	-27.68	-26.21	-19.13	-7.240	5.58	14.111	16.357	13.253	6.2244	-4.48	-18.37	-25.68
NORMAN WELLS A	TEMP(ALL)	STD_DEV	4.8900	3.9339	3.2557	3.0001	1.9107	1.4846	1.0896	1.6897	1.6714	2.4942	3.8914	3.8359
NORMAN WELLS A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
NORMAN WELLS A	TEMP(-71)	AVG	-25.94	-25.68	-19.53	-6.982	6.2941	14.811	16.876	13.405	6.8294	-5.070	-18.76	-25.32
NORMAN WELLS A	TEMP(-71)	STD_DEV	5.3324	4.4723	2.3431	2.6765	2.3880	1.1493	1.2817	1.2693	1.9207	2.6204	4.2750	3.9973
PINE POINT	SNOW(ALL)	COUNT	0	0	1	1	1	1	1	1	1	0	1	0
PINE POINT	SNOW(ALL)	AVG	ERR	ERR	33	0	0	0	0	0	0	ERR	58	ERR
PINE POINT	SNOW(ALL)	STD_DEV	ERR	ERR	0	0	0	0	0	0	0	ERR	0	ERR
PINE POINT	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
PINE POINT	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	PREP(ALL)	COUNT	1	1	2	2	2	3	3	3	3	2	3	2
PINE POINT	PREP(ALL)	AVG	76	66	136	71.5	115.5	247.33	389.33	711	389.33	322.5	513.33	400
PINE POINT	PREP(ALL)	STD_DEV	0	0	57	25.5	39.5	166.36	183.09	287.85	154.00	15.5	32.293	187
PINE POINT	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
PINE POINT	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	TEMP(ALL)	COUNT	1	1	2	2	2	2	2	2	2	2	2	2
PINE POINT	TEMP(ALL)	AVG	-30.8	-19.2	-12.75	-7.2	6.75	13.4	16.4	15.3	6.25	1.5	-6.9	-16.45
PINE POINT	TEMP(ALL)	STD_DEV	0	0	0.45	7.1	1.25	0.7	0.3	1	2.25	0.4	0.4	1.85
PINE POINT	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
PINE POINT	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
PINE POINT	SNOW(ALL)	COUNT	2	3	4	3	9	10	12	12	12	2	5	1
PINE POINT	SNOW(ALL)	AVG	25.5	25	21.25	0.6666	0	0	0	0	0	17.5	15.6	0
PINE POINT	SNOW(ALL)	STD_DEV	10.5	4.8989	11.497	0.9428	0	0	0	0	0	0.5	8.6856	0
PINE POINT	SNOW(71-)	COUNT	2	3	4	3	9	10	12	12	12	2	5	1
PINE POINT	SNOW(71-)	AVG	25.5	25	21.25	0.6666	0	0	0	0	0	17.5	15.6	0
PINE POINT	SNOW(71-)	STD_DEV	10.5	4.8989	11.497	0.9428	0	0	0	0	0	0.5	8.6856	0
PINE POINT	PREP(ALL)	COUNT	9	9	9	6	9	10	12	11	11	12	10	9
PINE POINT	PREP(ALL)	AVG	213.33	110.44	132.77	42.166	231.88	303.8	375.33	575.18	349.45	332.83	325.4	172.11

PINE POINT	PREP(ALL)	STD_DEV	159.28	92.614	80.171	49.582	112.84	113.55	247.95	395.71	123.19	184.52	211.02	157.63
PINE POINT	PREP(-71)	COUNT	9	9	9	6	9	10	12	11	11	12	10	9
PINE POINT	PREP(-71)	AVG	213.33	110.44	132.77	42.166	231.88	303.8	375.33	575.18	349.45	332.83	325.4	172.11
PINE POINT	PREP(-71)	STD_DEV	159.28	92.614	80.171	49.582	112.84	113.55	247.95	395.71	123.19	184.52	211.02	157.63
PINE POINT	TEMP(ALL)	COUNT	6	8	8	5	8	10	12	11	12	9	10	9
PINE POINT	TEMP(ALL)	AVG	-18.91	-22.08	-14.82	-0.32	6.6	13.05	15.966	14.227	8.3083	0.6111	-12.19	-20.42
PINE POINT	TEMP(ALL)	STD_DEV	5.3732	5.5279	3.3379	3.8669	2.3291	0.7787	1.5018	2.0802	1.8933	2.0978	4.8609	4.3641
PINE POINT	TEMP(-71)	COUNT	6	8	8	5	8	10	12	11	12	9	10	9
PINE POINT	TEMP(-71)	AVG	-18.91	-22.08	-14.82	-0.32	6.6	13.05	15.966	14.227	8.3083	0.6111	-12.19	-20.42
PINE POINT	TEMP(-71)	STD_DEV	5.3732	5.5279	3.3379	3.8669	2.3291	0.7787	1.5018	2.0802	1.8933	2.0978	4.8609	4.3641
RAINBOW RS	SNOW(ALL)	COUNT	5	4	4	5	10	11	10	8	6	5	4	3
RAINBOW RS	SNOW(ALL)	AVG	40.2	55	56.5	0	0	0	0	0	0	3	24.25	37.666
RAINBOW RS	SNOW(ALL)	STD_DEV	20.865	9.8953	8.0777	0	0	0	0	0	0	4.6475	13.645	6.1282
RAINBOW RS	SNOW(71-)	COUNT	5	4	4	5	9	10	9	7	6	5	4	3
RAINBOW RS	SNOW(71-)	AVG	40.2	55	56.5	0	0	0	0	0	0	3	24.25	37.666
RAINBOW RS	SNOW(71-)	STD_DEV	20.865	9.8953	8.0777	0	0	0	0	0	0	4.6475	13.645	6.1282
RAINBOW RS	PREP(ALL)	COUNT	4	6	6	9	11	11	11	8	7	8	7	4
RAINBOW RS	PREP(ALL)	AVG	238.25	171.83	252.66	125.33	447.90	809.54	731	884.37	388	197	204.42	147.75
RAINBOW RS	PREP(ALL)	STD_DEV	101.52	144.63	154.46	94.096	285.74	237.74	252.85	353.12	131.18	170.01	111.81	35.492
RAINBOW RS	PREP(-71)	COUNT	4	5	5	9	10	10	10	7	7	7	6	4
RAINBOW RS	PREP(-71)	AVG	238.25	186.8	251.8	125.33	439.4	810	758.9	843.42	388	212.85	208.5	147.75
RAINBOW RS	PREP(-71)	STD_DEV	101.52	154.14	169.19	94.096	277.28	249.34	248.52	372.83	131.18	176.13	120.29	35.492
RAINBOW RS	TEMP(ALL)	COUNT	4	6	6	8	11	11	11	8	7	8	7	5
RAINBOW RS	TEMP(ALL)	AVG	-15.95	-14.1	-9.783	2.6	9.0090	13.109	14.7	12.612	7.2428	0.7125	-10.55	-11.86
RAINBOW RS	TEMP(ALL)	STD_DEV	3.9296	3.2639	1.6536	2.2265	1.7132	0.6894	1.2128	0.7473	1.8584	1.6197	5.0125	4.5120
RAINBOW RS	TEMP(-71)	COUNT	4	5	5	8	10	10	10	7	7	7	6	5
RAINBOW RS	TEMP(-71)	AVG	-15.95	-14.72	-10.02	2.6	9.1	13.04	14.76	12.557	7.2428	0.7428	-10.41	-11.86
RAINBOW RS	TEMP(-71)	STD_DEV	3.9296	3.2369	1.7162	2.2265	1.7714	0.6858	1.2563	0.7835	1.8584	1.7294	5.4013	4.5120
SHINGLE POINT A	SNOW(ALL)	COUNT	28	25	27	26	27	29	28	27	27	29	26	29
SHINGLE POINT A	SNOW(ALL)	AVG	26.928	28.32	30.629	24.538	5.0740	0	0	0.3333	4.9629	18.448	26.357	28.241
SHINGLE POINT A	SNOW(ALL)	STD_DEV	14.508	14.169	15.497	15.843	7.7312	0	0	0.9428	9.3273	10.243	15.104	14.609
SHINGLE POINT A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
SHINGLE POINT A	SNOW(71-)	AVG	28.647	29.705	31.470	22.941	5.5882	0	0	0.1764	5.2941	20.764	29.823	33.705
SHINGLE POINT A	SNOW(71-)	STD_DEV	15.788	15.720	17.378	15.857	8.7518	0	0	0.7058	10.614	9.4839	16.716	15.713
SHINGLE POINT A	PREP(ALL)	COUNT	29	27	26	26	26	27	25	29	29	28	29	29
SHINGLE POINT A	PREP(ALL)	AVG	80.241	57.592	70.423	95.076	107.65	238.81	355	504.24	311.13	275.57	137.24	79.714
SHINGLE POINT A	PREP(ALL)	STD_DEV	113.07	54.167	66.057	64.821	97.692	197.96	183.12	242.76	211.61	187.44	100.98	66.174
SHINGLE POINT A	PREP(-71)	COUNT	17	17	17	17	16	17	15	17	17	17	17	17
SHINGLE POINT A	PREP(-71)	AVG	71.294	73.647	71.235	98.941	123.18	285.76	330.6	581.70	362.47	297.41	171.82	104.17
SHINGLE POINT A	PREP(-71)	STD_DEV	75.378	60.678	59.920	63.317	103.35	212.08	185.81	221.37	181.44	126.17	110.44	74.175
SHINGLE POINT A	TEMP(ALL)	COUNT	24	22	27	29	29	30	30	29	31	30	28	28
SHINGLE POINT A	TEMP(ALL)	AVG	-25.31	-26.71	-25.03	-17.23	-4.762	5.52	10.92	8.6034	2.1387	-8.716	-19.10	-23.56
SHINGLE POINT A	TEMP(ALL)	STD_DEV	4.7814	4.3828	3.2840	3.0151	2.1745	1.7937	1.5780	2.1705	1.9514	2.7320	3.8123	3.2497
SHINGLE POINT A	TEMP(-71)	COUNT	15	14	17	17	17	17	17	17	17	17	17	17
SHINGLE POINT A	TEMP(-71)	AVG	-24.31	-25.96	-25.42	-17.88	-5.017	5.7941	11.017	8.6352	2.4882	-8.829	-19.12	-23.87
SHINGLE POINT A	TEMP(-71)	STD_DEV	4.9210	3.9687	3.0005	2.7008	2.3882	1.7075	1.5382	1.7983	2.1852	2.8878	4.3606	3.2408
SNOWDRIFT	SNOW(ALL)	COUNT	2	2	2	2	2	2	2	2	1	2	2	2
SNOWDRIFT	SNOW(ALL)	AVG	38.5	38	37	0	0	0	0	0	0	11.5	25.5	24
SNOWDRIFT	SNOW(ALL)	STD_DEV	2.5	5	1	0	0	0	0	0	0	8.5	10.5	9
SNOWDRIFT	SNOW(71-)	COUNT	2	2	2	2	2	2	2	2	1	2	2	2
SNOWDRIFT	SNOW(71-)	AVG	38.5	38	37	0	0	0	0	0	0	11.5	25.5	24
SNOWDRIFT	SNOW(71-)	STD_DEV	2.5	5	1	0	0	0	0	0	0	8.5	10.5	9
SNOWDRIFT	PREP(ALL)	COUNT	2	2	2	2	2	2	2	2	1	2	2	2
SNOWDRIFT	PREP(ALL)	AVG	203	38	279.5	30.5	198.5	462.5	486.5	1092	602	307	223.5	10
SNOWDRIFT	PREP(ALL)	STD_DEV	56	23	142.5	20.5	101.5	322.5	128.5	305	0	186	45.5	10
SNOWDRIFT	PREP(-71)	COUNT	2	2	2	2	2	2	2	2	1	2	2	2
SNOWDRIFT	PREP(-71)	AVG	203	38	279.5	30.5	198.5	462.5	486.5	1092	602	307	223.5	10
SNOWDRIFT	PREP(-71)	STD_DEV	56	23	142.5	20.5	101.5	322.5	128.5	305	0	186	45.5	10

SNOWDRIFT	TEMP(ALL)	COUNT	2	2	2	2	2	2	2	2	2	2	2	2
SNOWDRIFT	TEMP(ALL)	AVG	-27.35	-28.35	-20.4	-6.8	7.05	12.85	16.15	13.1	5.5	-0.95	-13.2	-24.25
SNOWDRIFT	TEMP(ALL)	STD_DEV	3.85	1.55	4.7	0.9	3.75	1.45	1.35	1.4	2.8	3.05	1.6	2.05
SNOWDRIFT	TEMP(-71)	COUNT	2	2	2	2	2	2	2	2	2	2	2	2
SNOWDRIFT	TEMP(-71)	AVG	-27.35	-28.35	-20.4	-6.8	7.05	12.85	16.15	13.1	5.5	-0.95	-13.2	-24.25
SNOWDRIFT	TEMP(-71)	STD_DEV	3.85	1.55	4.7	0.9	3.75	1.45	1.35	1.4	2.8	3.05	1.6	2.05
SANS SAULT RAPIDS	SNOW(ALL)	COUNT	0	0	0	0	0	0	1	1	2	0	0	0
SANS SAULT RAPIDS	SNOW(ALL)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	0	0	0	ERR	ERR	ERR
SANS SAULT RAPIDS	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	0	0	0	ERR	ERR	ERR
SANS SAULT RAPIDS	SNOW(71-)	COUNT	0	0	0	0	0	0	1	1	2	0	0	0
SANS SAULT RAPIDS	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	0	0	0	ERR	ERR	ERR
SANS SAULT RAPIDS	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	0	0	0	ERR	ERR	ERR
SANS SAULT RAPIDS	PREP(ALL)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
SANS SAULT RAPIDS	PREP(ALL)	AVG	581.5	262	183	528	577	414	208	880	446	327.5	153.5	420.5
SANS SAULT RAPIDS	PREP(ALL)	STD_DEV	114.5	0	0	0	0	0	0	420	90	20.5	11.5	123.5
SANS SAULT RAPIDS	PREP(-71)	COUNT	2	1	1	1	1	1	1	2	2	2	2	2
SANS SAULT RAPIDS	PREP(-71)	AVG	581.5	262	183	528	577	414	208	880	446	327.5	153.5	420.5
SANS SAULT RAPIDS	PREP(-71)	STD_DEV	114.5	0	0	0	0	0	0	420	90	20.5	11.5	123.5
SANS SAULT RAPIDS	TEMP(ALL)	COUNT	3	2	2	2	2	2	2	2	2	2	2	2
SANS SAULT RAPIDS	TEMP(ALL)	AVG	-30.16	-28.65	-21.45	-10.1	4.95	15.45	17	14.05	4.7	-4.35	-20.6	-25.4
SANS SAULT RAPIDS	TEMP(ALL)	STD_DEV	4.0002	1.15	0.05	1	1.55	0.55	0.2	2.25	1.7	0.15	0.9	2.5
SANS SAULT RAPIDS	TEMP(-71)	COUNT	3	2	2	2	2	2	2	2	2	2	2	2
SANS SAULT RAPIDS	TEMP(-71)	AVG	-30.16	-28.65	-21.45	-10.1	4.95	15.45	17	14.05	4.7	-4.35	-20.6	-25.4
SANS SAULT RAPIDS	TEMP(-71)	STD_DEV	4.0002	1.15	0.05	1	1.55	0.55	0.2	2.25	1.7	0.15	0.9	2.5
STEEN RIVER RS	SNOW(ALL)	COUNT	1	1	2	1	6	5	7	5	5	3	3	1
STEEN RIVER RS	SNOW(ALL)	AVG	0	58	21.5	0	0	0	0	0	0	17	21	43
STEEN RIVER RS	SNOW(ALL)	STD_DEV	0	0	21.5	0	0	0	0	0	0	17.454	14.165	0
STEEN RIVER RS	SNOW(71-)	COUNT	1	0	1	0	2	2	2	0	0	1	1	0
STEEN RIVER RS	SNOW(71-)	AVG	0	ERR	0	ERR	0	0	0	ERR	ERR	0	2	ERR
STEEN RIVER RS	SNOW(71-)	STD_DEV	0	ERR	0	ERR	0	0	0	ERR	ERR	0	0	ERR
STEEN RIVER RS	PREP(ALL)	COUNT	6	5	5	3	4	6	7	5	5	4	5	5
STEEN RIVER RS	PREP(ALL)	AVG	151	92.4	145.8	132	125	456	564	553.2	262.4	239.25	214.4	221.4
STEEN RIVER RS	PREP(ALL)	STD_DEV	58.318	69.643	35.317	59.031	53.150	223.66	160.54	289.96	152.80	156.01	51.794	117.69
STEEN RIVER RS	PREP(-71)	COUNT	4	4	3	1	1	2	2	0	0	1	2	3
STEEN RIVER RS	PREP(-71)	AVG	164.25	76.25	166.66	190	152	472.5	456.5	ERR	ERR	0	222	286.33
STEEN RIVER RS	PREP(-71)	STD_DEV	67.614	68.983	29.769	0	0	143.5	14.5	ERR	ERR	0	70	121.41
STEEN RIVER RS	TEMP(ALL)	COUNT	6	6	7	5	3	6	7	5	4	4	5	6
STEEN RIVER RS	TEMP(ALL)	AVG	-24.6	-19.41	-12.88	-2.2	8.5333	13.7	15.614	13.94	7.65	0.55	-14.3	-21.31
STEEN RIVER RS	TEMP(ALL)	STD_DEV	3.9770	7.1151	2.6319	3.3746	0.9877	0.7810	1.8886	0.9971	1.2737	2.1834	3.8541	3.1216
STEEN RIVER RS	TEMP(-71)	COUNT	4	5	5	3	0	2	2	0	0	1	2	4
STEEN RIVER RS	TEMP(-71)	AVG	-22.72	-19	-12.66	-0.7	ERR	12.85	15.4	ERR	ERR	1.8	-11.65	-21.77
STEEN RIVER RS	TEMP(-71)	STD_DEV	2.4014	7.7270	2.2428	3.3970	ERR	0.15	2.4	ERR	ERR	0	2.35	3.7291
STOKES POINT	SNOW(ALL)	COUNT	5	5	5	4	4	2	2	1	2	3	3	4
STOKES POINT	SNOW(ALL)	AVG	24.8	29.4	26.2	30.75	6.5	0	0	0	5	23.333	23.666	17.75
STOKES POINT	SNOW(ALL)	STD_DEV	8.0845	10.190	10.107	10.985	6.5	0	0	0	0	6.2360	8.9566	9.9069
STOKES POINT	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
STOKES POINT	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
STOKES POINT	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
STOKES POINT	PREP(ALL)	COUNT	5	4	5	5	5	4	4	3	3	3	4	4
STOKES POINT	PREP(ALL)	AVG	131	79.5	26	59.8	28	99.75	145.5	150.66	112	206	72	38
STOKES POINT	PREP(ALL)	STD_DEV	88.618	66.334	50.513	70.957	56	171.04	151.55	180.96	62.455	51.231	61.493	52.387
STOKES POINT	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
STOKES POINT	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
STOKES POINT	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
STOKES POINT	TEMP(ALL)	COUNT	3	3	4	5	5	4	5	4	4	3	3	3
STOKES POINT	TEMP(ALL)	AVG	-24.83	-22.5	-26.45	-17.78	-4.46	2.325	7.98	6.55	0.675	-8.966	-20.66	-23.13
STOKES POINT	TEMP(ALL)	STD_DEV	3.6609	1.7107	2.0377	3.0825	1.6596	0.5402	1.6178	2.1937	0.5251	2.0336	2.4362	3.1594
STOKES POINT	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0

STOKES POINT	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
STOKES POINT	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TSICHU RIVER	SNOW(ALL)	COUNT	5	4	6	6	7	7	7	7	3	5	6	6
TSICHU RIVER	SNOW(ALL)	AVG	68.2	70.75	85.833	76.166	8.2857	0	0	0	0	41.6	40	59.5
TSICHU RIVER	SNOW(ALL)	STD_DEV	26.301	22.543	22.696	20.618	13.956	0	0	0	0	17.304	11.590	11.968
TSICHU RIVER	SNOW(71-)	COUNT	5	4	6	6	7	7	7	7	3	5	6	6
TSICHU RIVER	SNOW(71-)	AVG	68.2	70.75	85.833	76.166	8.2857	0	0	0	0	41.6	40	59.5
TSICHU RIVER	SNOW(71-)	STD_DEV	26.301	22.543	22.696	20.618	13.956	0	0	0	0	17.304	11.590	11.968
TSICHU RIVER	PREP(ALL)	COUNT	8	7	8	7	7	8	7	8	7	7	8	7
TSICHU RIVER	PREP(ALL)	AVG	262	209.14	258.75	245.71	187.28	399.12	585.85	637.5	407.42	590.14	469.12	336.14
TSICHU RIVER	PREP(ALL)	STD_DEV	190.07	86.214	153.80	147.62	117.00	171.01	149.29	138.19	155.66	355.81	124.03	140.24
TSICHU RIVER	PREP(-71)	COUNT	8	7	8	7	7	8	7	8	7	7	8	7
TSICHU RIVER	PREP(-71)	AVG	262	209.14	258.75	245.71	187.28	399.12	585.85	637.5	407.42	590.14	469.12	336.14
TSICHU RIVER	PREP(-71)	STD_DEV	190.07	86.214	153.80	147.62	117.00	171.01	149.29	138.19	155.66	355.81	124.03	140.24
TSICHU RIVER	TEMP(ALL)	COUNT	8	7	8	7	7	8	7	8	7	7	7	7
TSICHU RIVER	TEMP(ALL)	AVG	-24	-22.37	-18.55	-10.41	0.2857	7.4125	10.4	8.2666	2.6714	-5.228	-15.9	-23.32
TSICHU RIVER	TEMP(ALL)	STD_DEV	3.8362	7.5618	2.6182	1.6965	1.1993	1.0517	0.9180	0.8730	1.2267	2.2166	5.0894	4.0347
TSICHU RIVER	TEMP(-71)	COUNT	8	7	8	7	7	8	7	8	7	7	7	7
TSICHU RIVER	TEMP(-71)	AVG	-24	-22.37	-18.55	-10.41	0.2857	7.4125	10.4	8.2666	2.6714	-5.228	-15.9	-23.32
TSICHU RIVER	TEMP(-71)	STD_DEV	3.8362	7.5618	2.6182	1.6965	1.1993	1.0517	0.9180	0.8730	1.2267	2.2166	5.0894	4.0347
TUKTOYAKTUK	SNOW(ALL)	COUNT	30	30	30	30	30	31	31	31	31	31	31	31
TUKTOYAKTUK	SNOW(ALL)	AVG	26.4	30	31.866	26.4	2.7666	0	0	0	1.6774	13.580	19.193	22.903
TUKTOYAKTUK	SNOW(ALL)	STD_DEV	11.819	13.228	14.743	16.914	3.1694	0	0	0	3.8553	8.2492	8.6487	9.4163
TUKTOYAKTUK	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
TUKTOYAKTUK	SNOW(71-)	AVG	29.058	32.411	34.882	32.058	2.6470	0	0	0	1.5294	14.470	21.764	24.623
TUKTOYAKTUK	SNOW(71-)	STD_DEV	12.373	14.641	15.445	18.750	3.4117	0	0	0	2.9727	8.9516	9.8848	10.901
TUKTOYAKTUK	PREP(ALL)	COUNT	30	30	30	30	30	31	30	31	31	31	31	30
TUKTOYAKTUK	PREP(ALL)	AVG	56.833	54.533	40.466	69.033	61.6	114.16	203.13	278.90	163.51	185.03	85.967	80.633
TUKTOYAKTUK	PREP(ALL)	STD_DEV	50.979	47.749	42.682	57.498	68.819	102.72	122.64	166.89	90.921	106.27	65.234	63.474
TUKTOYAKTUK	PREP(-71)	COUNT	17	17	17	17	17	17	16	17	17	17	17	17
TUKTOYAKTUK	PREP(-71)	AVG	62.235	56	43.941	84.411	53.705	97.470	188.43	272.23	184.11	233.70	115.29	83.411
TUKTOYAKTUK	PREP(-71)	STD_DEV	44.679	43.250	44.920	60.245	57.901	87.550	97.409	116.57	94.522	110.01	65.816	61.386
TUKTOYAKTUK	TEMP(ALL)	COUNT	27	26	30	30	30	30	30	30	31	31	31	30
TUKTOYAKTUK	TEMP(ALL)	AVG	-27.76	-28.52	-26.23	-17.30	-4.866	5.2666	10.5	8.9066	2.7612	-7.761	-19.99	-24.81
TUKTOYAKTUK	TEMP(ALL)	STD_DEV	4.2508	3.5436	2.8732	2.9856	2.1589	1.6023	1.7227	1.7542	1.8459	2.6791	3.3435	3.2699
TUKTOYAKTUK	TEMP(-71)	COUNT	15	14	17	17	17	17	17	17	17	17	17	17
TUKTOYAKTUK	TEMP(-71)	AVG	-26.49	-27.54	-26.46	-17.40	-4.954	5.6	10.535	8.9941	3.1470	-7.882	-19.47	-25.03
TUKTOYAKTUK	TEMP(-71)	STD_DEV	5.0245	3.5104	2.8711	2.6522	2.4690	1.7317	1.9047	1.3786	2.0585	2.9135	3.9320	3.3272
TUKTOYAKTUK A	SNOW(ALL)	COUNT	13	14	17	17	15	17	18	17	12	15	14	15
TUKTOYAKTUK A	SNOW(ALL)	AVG	31.307	35.5	38.235	34.294	7.2666	0	0	0	1.8333	11.533	22.5	27.6
TUKTOYAKTUK A	SNOW(ALL)	STD_DEV	14.220	14.989	16.975	15.991	11.812	0	0	0	3.0776	6.1629	9.4547	12.009
TUKTOYAKTUK A	SNOW(71-)	COUNT	13	14	17	16	15	16	17	16	12	15	14	15
TUKTOYAKTUK A	SNOW(71-)	AVG	31.307	35.5	38.235	34.875	7.2666	0	0	0	1.8333	11.533	22.5	27.6
TUKTOYAKTUK A	SNOW(71-)	STD_DEV	14.220	14.989	16.975	16.309	11.812	0	0	0	3.0776	6.1629	9.4547	12.009
TUKTOYAKTUK A	PREP(ALL)	COUNT	14	14	17	16	15	18	18	17	14	13	15	15
TUKTOYAKTUK A	PREP(ALL)	AVG	94.214	96.571	56.352	99.312	65.733	104.5	225.11	308.52	233.14	224.69	136.46	115.73
TUKTOYAKTUK A	PREP(ALL)	STD_DEV	46.325	71.505	52.206	72.811	57.692	65.626	175.87	115.02	109.54	87.424	82.177	84.261
TUKTOYAKTUK A	PREP(-71)	COUNT	14	14	17	16	15	17	17	16	14	13	15	15
TUKTOYAKTUK A	PREP(-71)	AVG	94.214	96.571	56.352	99.312	65.733	101.23	234.58	321.93	233.14	224.69	136.46	115.73
TUKTOYAKTUK A	PREP(-71)	STD_DEV	46.325	71.505	52.206	72.811	57.692	66.093	176.44	104.89	109.54	87.424	82.177	84.261
TUKTOYAKTUK A	TEMP(ALL)	COUNT	14	14	17	15	15	18	18	17	14	14	15	15
TUKTOYAKTUK A	TEMP(ALL)	AVG	-26.86	-27.77	-26.92	-17.79	-4.96	5.6388	10.616	8.9294	2.95	-8.192	-19.69	-25.39
TUKTOYAKTUK A	TEMP(ALL)	STD_DEV	4.9784	3.5209	2.8610	2.5990	2.2945	1.7127	1.8424	1.4478	2.0475	3.2630	4.1576	3.4004
TUKTOYAKTUK A	TEMP(-71)	COUNT	14	14	17	15	15	17	17	16	14	14	15	15
TUKTOYAKTUK A	TEMP(-71)	AVG	-26.86	-27.77	-26.92	-17.79	-4.96	5.7117	10.552	8.8125	2.95	-8.192	-19.69	-25.39
TUKTOYAKTUK A	TEMP(-71)	STD_DEV	4.9784	3.5209	2.8610	2.5990	2.2945	1.7350	1.8765	1.4123	2.0475	3.2630	4.1576	3.4004
TUNGSTEN	SNOW(ALL)	COUNT	13	12	12	12	15	19	20	21	16	12	12	11
TUNGSTEN	SNOW(ALL)	AVG	86.615	104.58	102.91	45.833	0	0	0	0.0952	1.1875	26.5	48.833	68.363

TUNGSTEN	SNOW(ALL)	STD_DEV	28.789	23.282	27.442	45.491	0	0	0	0.4259	3.1467	14.991	19.251	32.023
TUNGSTEN	SNOW(71-)	COUNT	12	11	12	12	14	15	16	17	13	12	12	11
TUNGSTEN	SNOW(71-)	AVG	88.333	105.27	102.91	45.833	0	0	0	0.1176	1.4615	26.5	48.833	68.363
TUNGSTEN	SNOW(71-)	STD_DEV	29.318	24.200	27.442	45.491	0	0	0	0.4705	3.4332	14.991	19.251	32.023
TUNGSTEN	PREP(ALL)	COUNT	18	19	21	16	15	19	19	20	20	18	20	21
TUNGSTEN	PREP(ALL)	AVG	409.33	333.47	309.14	417.93	396.06	613.36	880.68	843.7	611	743.88	511.3	345.61
TUNGSTEN	PREP(ALL)	STD_DEV	364.20	230.81	218.95	297.05	185.38	239.61	290.88	283.85	228.52	400.85	249.79	204.62
TUNGSTEN	PREP(-71)	COUNT	15	15	17	15	15	15	15	16	16	14	16	17
TUNGSTEN	PREP(-71)	AVG	458.53	360.26	343.52	434.46	396.06	583.66	835.8	842.68	597.31	774.64	458.87	370.35
TUNGSTEN	PREP(-71)	STD_DEV	378.95	233.93	223.63	299.58	185.38	230.13	276.58	300.18	222.36	426.99	206.87	217.57
TUNGSTEN	TEMP(ALL)	COUNT	19	19	20	17	17	19	19	19	20	20	22	21
TUNGSTEN	TEMP(ALL)	AVG	-22.31	-18.06	-12.99	-5	2.9882	9	11.152	8.9263	3.4	-4.17	-15.3	-19.87
TUNGSTEN	TEMP(ALL)	STD_DEV	6.2513	4.6405	2.7315	2.2204	1.2894	0.9787	1.0059	1.0145	1.3194	1.7135	4.2835	4.8262
TUNGSTEN	TEMP(-71)	COUNT	15	15	16	16	15	15	16	17	16	15	17	17
TUNGSTEN	TEMP(-71)	AVG	-21.36	-18.24	-13.01	-4.918	3.0066	8.8733	11.368	8.8941	3.4187	-4	-15.14	-19.88
TUNGSTEN	TEMP(-71)	STD_DEV	6.4228	5.0584	2.3425	2.2641	1.3473	0.9801	0.9332	1.0321	1.4076	1.7587	4.4880	4.9141
TUNUNUK	SNOW(ALL)	COUNT	4	3	3	5	4	2	2	3	3	4	2	4
TUNUNUK	SNOW(ALL)	AVG	25	20.333	18.666	26.2	0.75	0	0	0	0	11.5	11.5	13.25
TUNUNUK	SNOW(ALL)	STD_DEV	14.645	12.552	13.695	14.427	1.2990	0	0	0	0	5.6789	1.5	7.1894
TUNUNUK	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TUNUNUK	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TUNUNUK	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TUNUNUK	PREP(ALL)	COUNT	5	3	3	3	4	4	5	4	4	4	4	4
TUNUNUK	PREP(ALL)	AVG	130	32	38	86.666	29.75	102.25	312.6	527.75	243.75	142.25	17.25	35.25
TUNUNUK	PREP(ALL)	STD_DEV	79.427	14.764	37.478	78.969	43.303	91.387	200.04	198.87	141.31	82.964	29.877	41.475
TUNUNUK	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TUNUNUK	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TUNUNUK	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TUNUNUK	TEMP(ALL)	COUNT	3	4	4	5	5	4	5	4	4	4	4	4
TUNUNUK	TEMP(ALL)	AVG	-27.4	-23.1	-25.1	-15.64	-3.3	7.725	11.52	9.3	1.8	-7.8	-22.47	-24.6
TUNUNUK	TEMP(ALL)	STD_DEV	2.9200	2.5465	1.3435	2.9465	2.3125	0.6722	1.1545	2.1691	0.7176	2.0481	2.2938	2.5739
TUNUNUK	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TUNUNUK	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TUNUNUK	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	SNOW(ALL)	COUNT	0	0	0	1	2	0	0	2	2	2	0	0
TWIN GORGES	SNOW(ALL)	AVG	ERR	ERR	ERR	0	0	ERR	ERR	0	0	0	ERR	ERR
TWIN GORGES	SNOW(ALL)	STD_DEV	ERR	ERR	ERR	0	0	ERR	ERR	0	0	0	ERR	ERR
TWIN GORGES	SNOW(71-)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TWIN GORGES	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	PREP(ALL)	COUNT	0	0	0	1	2	0	0	1	2	2	1	0
TWIN GORGES	PREP(ALL)	AVG	ERR	ERR	ERR	117	305	ERR	ERR	277	293.5	184	127	ERR
TWIN GORGES	PREP(ALL)	STD_DEV	ERR	ERR	ERR	0	226	ERR	ERR	0	36.5	154	0	ERR
TWIN GORGES	PREP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TWIN GORGES	PREP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	TEMP(ALL)	COUNT	0	1	0	1	2	0	0	1	1	2	1	0
TWIN GORGES	TEMP(ALL)	AVG	ERR	-17.8	ERR	0.3	7	ERR	ERR	12.7	6.3	-0.4	-11.6	ERR
TWIN GORGES	TEMP(ALL)	STD_DEV	ERR	0	ERR	0	0.6	ERR	ERR	0	0	0.7	0	ERR
TWIN GORGES	TEMP(-71)	COUNT	0	0	0	0	0	0	0	0	0	0	0	0
TWIN GORGES	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
TWIN GORGES	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR	ERR
UPPER HAY RIVER RS	SNOW(ALL)	COUNT	3	2	1	3	5	5	4	4	3	2	2	1
UPPER HAY RIVER RS	SNOW(ALL)	AVG	45	76.5	3	0	0	0	0	0	0	12.5	28	23
UPPER HAY RIVER RS	SNOW(ALL)	STD_DEV	14.165	35.5	0	0	0	0	0	0	0	7.5	10	0
UPPER HAY RIVER RS	SNOW(71-)	COUNT	0	0	0	0	1	1	0	0	0	0	0	0
UPPER HAY RIVER RS	SNOW(71-)	AVG	ERR	ERR	ERR	ERR	0	0	ERR	ERR	ERR	ERR	ERR	ERR
UPPER HAY RIVER RS	SNOW(71-)	STD_DEV	ERR	ERR	ERR	ERR	0	0	ERR	ERR	ERR	ERR	ERR	ERR

UPPER HAY RIVER RS	PREP(ALL)	COUNT	4	4	2	4	5	5	4	4	3	2	4	4
UPPER HAY RIVER RS	PREP(ALL)	AVG	182.5	229.25	99	260	228.6	278.2	868.25	248.75	305	311.5	381	233
UPPER HAY RIVER RS	PREP(ALL)	STD_DEV	83.649	86.050	5	119.79	89.515	131.90	359.34	269.98	131.50	82.5	95.034	93.880
UPPER HAY RIVER RS	PREP(-71)	COUNT	0	0	0	0	1	1	0	0	0	0	0	0
UPPER HAY RIVER RS	PREP(-71)	AVG	ERR	ERR	ERR	ERR	170	343	ERR	ERR	ERR	ERR	ERR	ERR
UPPER HAY RIVER RS	PREP(-71)	STD_DEV	ERR	ERR	ERR	ERR	0	0	ERR	ERR	ERR	ERR	ERR	ERR
UPPER HAY RIVER RS	TEMP(ALL)	COUNT	4	4	2	4	4	5	3	4	3	1	4	3
UPPER HAY RIVER RS	TEMP(ALL)	AVG	-30.37	-18.52	-13.6	0.15	9.275	13.52	14.366	13.375	9.2333	-0.3	-14.87	-17.76
UPPER HAY RIVER RS	TEMP(ALL)	STD_DEV	5.4737	1.9227	3.2	4.1883	0.9337	0.9867	1.2814	1.1098	1.4817	0	3.3424	3.8125
UPPER HAY RIVER RS	TEMP(-71)	COUNT	0	0	0	0	1	1	0	0	0	0	0	0
UPPER HAY RIVER RS	TEMP(-71)	AVG	ERR	ERR	ERR	ERR	10.6	14.4	ERR	ERR	ERR	ERR	ERR	ERR
UPPER HAY RIVER RS	TEMP(-71)	STD_DEV	ERR	ERR	ERR	ERR	0	0	ERR	ERR	ERR	ERR	ERR	ERR
WRIGLEY A	SNOW(ALL)	COUNT	24	28	26	29	26	26	27	27	24	27	30	26
WRIGLEY A	SNOW(ALL)	AVG	53.75	63.285	61.692	22	0	0	0	0	0.8666	16.555	25.7	39.269
WRIGLEY A	SNOW(ALL)	STD_DEV	20.129	26.447	31.057	25.272	0	0	0	0	2.1147	11.704	13.545	17.243
WRIGLEY A	SNOW(71-)	COUNT	9	9	9	11	14	17	17	17	14	10	12	8
WRIGLEY A	SNOW(71-)	AVG	50	56.222	50.777	22.545	0	0	0	0	0.7142	19.4	23.5	36.625
WRIGLEY A	SNOW(71-)	STD_DEV	18.814	16.903	20.345	30.446	0	0	0	0	2.5753	13.734	15.971	19.563
WRIGLEY A	PREP(ALL)	COUNT	34	38	40	35	36	36	35	39	41	36	40	33
WRIGLEY A	PREP(ALL)	AVG	194.41	128.02	125	163.31	252.55	439.77	534.6	477.53	314.56	316.44	204.92	195.60
WRIGLEY A	PREP(ALL)	STD_DEV	124.46	68.642	90.146	113.65	165.75	231.97	243.16	269.68	188.18	191.67	114.14	104.53
WRIGLEY A	PREP(-71)	COUNT	12	14	15	11	14	15	14	14	16	13	16	9
WRIGLEY A	PREP(-71)	AVG	177.66	124.92	143.4	191.90	283.14	507.46	546.85	497.78	286.75	356.61	187.87	192.88
WRIGLEY A	PREP(-71)	STD_DEV	60.771	66.368	83.372	103.67	154.92	237.98	284.14	287.91	187.82	193.37	93.814	80.800
WRIGLEY A	TEMP(ALL)	COUNT	32	39	38	36	38	39	38	40	43	35	41	32
WRIGLEY A	TEMP(ALL)	AVG	-28.54	-24.62	-16.23	-3.625	7.2657	14.174	16.328	13.672	6.6790	-3.18	-17.45	-25.37
WRIGLEY A	TEMP(ALL)	STD_DEV	4.3911	3.8361	2.9564	2.9074	1.4471	1.1905	1.0333	1.6871	1.7522	2.5742	3.9833	3.9195
WRIGLEY A	TEMP(-71)	COUNT	10	15	13	13	15	14	12	13	16	11	17	8
WRIGLEY A	TEMP(-71)	AVG	-26.69	-24.73	-16.92	-3.4	7.5133	14.55	16.575	13.553	6.7625	-4.009	-17.51	-24.58
WRIGLEY A	TEMP(-71)	STD_DEV	4.4423	4.6082	1.8831	3.0641	1.8351	1.0411	1.2891	1.2573	2.0272	2.2773	4.3764	3.8789
YELLOWKNIFE A	SNOW(ALL)	COUNT	35	35	36	34	35	39	40	41	35	35	35	35
YELLOWKNIFE A	SNOW(ALL)	AVG	33.514	39.628	37.638	10.676	0	0	0	0	0.7714	7.0857	21.257	28.371
YELLOWKNIFE A	SNOW(ALL)	STD_DEV	14.341	14.724	16.090	12.494	0	0	0	0	1.9136	7.2952	9.5059	12.146
YELLOWKNIFE A	SNOW(71-)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
YELLOWKNIFE A	SNOW(71-)	AVG	32.117	38.705	37.176	6.4117	0	0	0	0	1	7.4117	21.588	26
YELLOWKNIFE A	SNOW(71-)	STD_DEV	14.003	12.517	14.427	8.9578	0	0	0	0	2.1962	7.2360	10.415	13.015
YELLOWKNIFE A	PREP(ALL)	COUNT	45	45	45	45	45	45	46	46	46	46	46	45
YELLOWKNIFE A	PREP(ALL)	AVG	136.04	126.33	116.4	100.46	167.35	196.4	329.63	392.5	294.97	328.73	232.41	172.15
YELLOWKNIFE A	PREP(ALL)	STD_DEV	82.476	68.122	83.143	69.863	137.90	155.95	213.33	311.90	153.89	178.90	100.38	97.262
YELLOWKNIFE A	PREP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
YELLOWKNIFE A	PREP(-71)	AVG	132.52	134.82	113.88	99	211.70	235.70	325.41	441.47	318.41	386.82	222.70	150.70
YELLOWKNIFE A	PREP(-71)	STD_DEV	65.794	88.860	52.612	55.874	150.18	186.68	222.11	292.65	142.87	104.99	81.215	86.094
YELLOWKNIFE A	TEMP(ALL)	COUNT	45	45	45	45	45	45	46	46	46	45	46	45
YELLOWKNIFE A	TEMP(ALL)	AVG	-27.9	-25.08	-18.41	-6.957	4.74	12.593	16.206	14.034	6.8869	-1.417	-14.14	-23.94
YELLOWKNIFE A	TEMP(ALL)	STD_DEV	4.4410	4.2267	3.1994	3.8175	2.4246	1.8518	1.1419	1.5451	1.5730	2.3422	3.8118	4.2935
YELLOWKNIFE A	TEMP(-71)	COUNT	17	17	17	17	17	17	17	17	17	17	17	17
YELLOWKNIFE A	TEMP(-71)	AVG	-26.81	-24.02	-18.17	-5.405	5.9882	13.288	16.564	13.870	6.9294	-1.676	-14.01	-24.23
YELLOWKNIFE A	TEMP(-71)	STD_DEV	5.0624	5.1568	2.5224	3.4033	2.6722	1.2974	1.3168	1.5180	1.7596	2.0817	4.1471	4.6008
YELLOWKNIFW HYDRO	SNOW(ALL)	COUNT	10	7	9	13	18	25	25	23	23	7	9	9
YELLOWKNIFW HYDRO	SNOW(ALL)	AVG	35	38.428	47.777	11.615	0	0	0	0	0.2173	5.8571	19.111	35
YELLOWKNIFW HYDRO	SNOW(ALL)	STD_DEV	14.042	17.629	10.443	14.689	0	0	0	0	1.0196	8.3053	8.9993	5.9254
YELLOWKNIFW HYDRO	SNOW(71-)	COUNT	0	0	0	2	9	15	15	14	14	2	1	0
YELLOWKNIFW HYDRO	SNOW(71-)	AVG	ERR	ERR	ERR	0	0	0	0	0	0.3571	0	0	ERR
YELLOWKNIFW HYDRO	SNOW(71-)	STD_DEV	ERR	ERR	ERR	0	0	0	0	0	1.2876	0	0	ERR
YELLOWKNIFW HYDRO	PREP(ALL)	COUNT	41	42	41	42	42	43	43	43	43	42	42	43
YELLOWKNIFW HYDRO	PREP(ALL)	AVG	161.04	153.5	139.29	113.92	162.85	230.58	387.20	430.39	289.44	292.69	254.83	216.1
YELLOWKNIFW HYDRO	PREP(ALL)	STD_DEV	85.845	89.000	125.64	87.678	128.54	171.38	245.39	307.10	147.21	163.92	88.105	120.44
YELLOWKNIFW HYDRO	PREP(-71)	COUNT	14	14	13	14	14	15	15	14	16	14	14	13

YELLOWKNIFW HYDRO	PREP(-71)	AVG	179.5	194.07	133.92	107.07	196.85	276.93	371.53	439.21	299.87	325.07	286.42	238.38
YELLOWKNIFW HYDRO	PREP(-71)	STD_DEV	79.787	111.37	85.841	87.169	161.49	190.96	264.99	313.11	150.72	119.67	77.462	154.59
YELLOWKNIFW HYDRO	TEMP(ALL)	COUNT	41	42	41	42	42	43	43	41	42	41	42	40
YELLOWKNIFW HYDRO	TEMP(ALL)	AVG	-28.37	-25.92	-19.00	-7.804	3.6357	11.283	15.048	12.9	6.0761	-1.580	-14.48	-24.68
YELLOWKNIFW HYDRO	TEMP(ALL)	STD_DEV	4.4989	4.2691	3.3098	3.7345	2.2463	1.7364	1.1312	1.5859	1.4761	2.2378	3.8612	4.4806
YELLOWKNIFW HYDRO	TEMP(-71)	COUNT	14	14	13	14	14	15	15	14	16	14	14	13
YELLOWKNIFW HYDRO	TEMP(-71)	AVG	-26.7	-25.05	-18.87	-6.807	4.6	11.933	15.46	12.978	6.2937	-1.578	-14.30	-25.43
YELLOWKNIFW HYDRO	TEMP(-71)	STD_DEV	5.0372	5.3682	2.7251	3.1754	2.8330	1.3184	1.1217	1.4358	1.4694	1.9157	4.2356	4.3258

APPENDIX 2: UPPER AIR DATA STATISTICS

STATISTICAL SUMMARY FOR UPPER AIR DATA

NORMAN WELLS A (1981-1987)

TIME - 00 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	830	750	797	776	803	774	802	784	775	798	774	798	9461
	MEAN	-26.81	-23.99	-15.30	-2.85	9.12	17.83	20.14	17.45	9.97	-2.37	-17.37	-25.74	-3.35
	STD DEV	9.81	8.37	7.03	7.73	6.21	5.14	4.78	5.20	5.41	6.40	8.25	9.05	18.89
850 MB TEMP	N OBS	830	750	797	776	803	774	802	784	775	798	774	798	9461
	MEAN	-17.26	-15.80	-15.08	-9.00	-1.17	8.31	8.46	6.55	0.82	-5.61	-11.97	-15.39	-5.78
	STD DEV	10.39	10.66	8.17	7.17	6.10	4.58	4.28	4.87	5.59	6.79	8.50	9.84	11.95
NEAR SURFACE	N OBS	830	750	797	776	803	774	802	784	775	798	774	798	9461
TEMP GRAD	MEAN	0.0101	0.0006	-0.0047	-0.0083	-0.0079	-0.0095	-0.0095	-0.0096	-0.0090	-0.0071	0.0041	0.0143	-0.0030
	STD DEV	0.0241	0.0153	0.0102	0.0072	0.0095	0.0061	0.0060	0.0060	0.0048	0.0058	0.0184	0.0271	0.0161
SURFACE-85 KPA	N OBS	830	750	797	776	803	774	802	784	775	798	774	798	9461
TEMP GRAD	MEAN	0.0073	0.0064	0.0002	-0.0048	-0.0075	-0.0083	-0.0084	-0.0079	-0.0067	-0.0024	0.0043	0.0082	-0.0016
	STD DEV	0.0070	0.0067	0.0045	0.0033	0.0022	0.0016	0.0015	0.0018	0.0020	0.0041	0.0051	0.0072	0.0078
SURF INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURRENCE	AVG %	49.62%	33.79%	15.46%	7.85%	12.73%	4.[illegible]%	3.78%	3.00%	3.75%	7.14%	39.47%	53.75%	19.69%
	STD DEV	12.01%	14.73%	9.15%	5.24%	8.37%	4.49%	4.57%	3.13%	3.29%	7.82%	14.26%	13.47%	20.64%
UPP INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURRENCE	AVG %	41.60%	57.67%	49.72%	17.00%	1.01%	0.13%	0.50%	0.25%	1.94%	31.04%	47.23%	38.36%	24.04
	STD DEV	14.66%	16.72%	17.95%	12.73%	1.79%	0.64%	1.16%	0.87%	2.32%	15.25%	14.31%	12.97%	24.62
NO INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
	AVG %	8.77%	8.54%	34.82%	75.15%	86.26%	95.70%	95.73%	96.75%	94.31%	61.82%	13.30%	7.89%	56.26
	STD DEV	6.93%	8.19%	12.98%	14.18%	8.93%	4.5[illegible]%	4.66%	3.52%	3.9[illegible]%	14.07%	7.62%	5.60%	38.35

NORMAN WELLS A (1981-1987)

TIME - 12 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	826	752	797	778	798	773	796	776	774	795	770	798	9433
	MEAN	-27.96	-27.92	-23.45	-12.09	0.44	8.92	11.00	8.56	2.89	-5.67	-19.33	-26.20	-9.29
	STD DEV	10.37	9.77	8.52	8.33	4.92	4.03	3.70	4.29	4.14	6.06	8.82	9.44	16.46
850 MB TEMP	N OBS	826	752	797	778	798	773	796	776	774	795	770	798	9433
	MEAN	-17.43	-15.85	-14.86	-8.99	-1.47	5.67	7.77	6.12	0.52	-5.77	-12.11	-15.26	-6.00
	STD DEV	10.34	11.36	8.94	7.27	6.14	4.81	4.31	4.92	5.89	6.69	8.61	10.46	11.92
NEAR SURFACE	N OBS	826	752	797	778	798	773	796	776	774	795	770	798	9433
TEMP GRAD	MEAN	0.0170	0.0229	0.0285	0.0228	0.0141	0.0136	0.0186	0.0189	0.0133	0.0039	0.0136	0.0165	0.0170
	STD DEV	0.0300	0.0361	0.0395	0.0345	0.0235	0.0220	0.0253	0.0274	0.0239	0.0188	0.0287	0.0302	0.0295
SURFACE-85 KPA	N OBS	826	752	797	778	798	773	796	776	774	795	770	798	9433
TEMP GRAD	MEAN	0.0082	0.0096	0.0066	0.0024	-0.0015	-0.0024	-0.0023	-0.0018	-0.0018	-0.0000	0.0057	0.0086	0.0026
	STD DEV	0.0074	0.0083	0.0063	0.0050	0.0031	0.0025	0.0026	0.0032	0.0035	0.0044	0.0067	0.0080	0.0072
SURF INVERSION	N MTHS	27	27	28	28	28	28	28	28	28	28	28	28	314
OCCURRENCE	AVG %	55.69%	58.97%	65.86%	62.72%	62.41%	65.03%	71.85%	68.59%	58.64%	38.57%	48.67%	56.15%	59.25%
	STD DEV	10.79%	13.62%	11.93%	8.87%	9.22%	10.05%	7.40%	11.42%	12.41%	12.04%	11.99%	15.01%	14.58%
UPP INVERSION	N MTHS	27	27	28	28	28	28	28	28	28	28	28	28	314
OCCURRENCE	AVG %	35.27%	35.76%	28.25%	21.73%	10.45%	6.59%	2.62%	4.10%	5.56%	26.57%	40.16%	37.19%	21.44%
	STD DEV	14.07%	13.85%	12.31%	9.80%	7.79%	5.52%	2.54%	3.40%	3.34%	14.12%	13.16%	15.24%	17.58%
NO INVERSION	N MTHS	27	27	28	28	28	28	28	28	28	28	28	28	314
	AVG %	9.04%	5.27%	5.89%	15.54%	27.15%	28.38%	25.53%	27.31%	35.80%	34.86%	11.17%	6.66%	19.31%
	STD DEV	8.15%	6.01%	4.11%	7.14%	8.10%	9.72%	7.79%	11.26%	11.44%	12.69%	6.52%	5.95%	14.06%

INUVIK A (1961-1987)

TIME - 00 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	829	755	799	772	795	770	793	798	788	799	768	794	9440
	MEAN	-28.87	-26.25	-20.51	-10.85	1.74	14.08	17.16	14.08	6.40	-5.02	-19.10	-24.98	-6.78
	STD DEV	9.62	8.59	6.73	8.07	7.05	6.59	6.02	6.04	5.67	6.52	8.07	8.50	17.85
850 MB TEMP	N OBS	829	755	799	772	795	770	793	798	788	799	768	794	9440
	MEAN	-18.10	-18.00	-17.07	-11.40	-3.62	3.71	6.10	4.00	-1.85	-9.02	-14.41	-17.23	-8.08
	STD DEV	9.23	9.21	7.38	6.76	5.76	4.96	4.57	4.84	5.52	6.33	7.24	8.23	11.29
NEAR SURFACE	N OBS	829	755	799	772	795	770	793	798	788	799	768	794	9440
TEMP GRAD	MEAN	0.0179	0.0039	-0.0066	-0.0094	-0.0111	-0.0126	-0.0121	-0.0113	-0.0097	-0.0062	0.0113	0.0160	-0.0024
	STD DEV	0.0249	0.0154	0.0073	0.0057	0.0059	0.0059	0.0054	0.0047	0.0047	0.0064	0.0212	0.0241	0.0175
SURFACE-85 KPA	N OBS	829	755	799	772	795	770	793	798	788	799	768	794	9440
TEMP GRAD	MEAN	0.0069	0.0066	0.0027	-0.0035	-0.0040	-0.0076	-0.0080	-0.0074	-0.0061	-0.0023	0.0037	0.0062	-0.0008
	STD DEV	0.0058	0.0058	0.0039	0.0037	0.0035	0.0029	0.0024	0.0023	0.0023	0.0035	0.0045	0.0056	0.0069
SURF INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURRENCE	AVG %	71.63%	46.11%	12.82%	3.76%	2.29%	1.17%	0.62%	0.64%	0.91%	11.63%	62.41%	67.61%	23.70%
	STD DEV	9.15%	11.28%	9.60%	2.67%	4.01%	1.85%	1.79%	1.32%	1.76%	5.21%	10.75%	10.70%	28.98%
UPP INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURREACE	AVG %	23.08%	50.02%	75.18%	56.18%	21.92%	4.39%	1.38%	1.91%	3.66%	27.48%	28.91%	25.75%	26.72%
	STD DEV	8.48%	10.94%	14.23%	18.60%	14.72%	4.60%	2.57%	3.54%	4.12%	13.61%	9.43%	9.46%	24.91%
NO INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
	AVG %	5.29%	3.92%	12.00%	40.07%	75.88%	94.45%	98.00%	97.45%	95.42%	60.88%	8.68%	6.64%	49.58%
	STD DEV	7.55%	4.81%	11.29%	18.48%	16.42%	5.06%	3.12%	3.85%	4.90%	13.37%	5.28%	6.23%	40.62%

INUVIK A (1961-1987)

TIME - 12 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	830	755	800	776	800	774	797	794	773	797	765	800	9481
	MEAN	-27.33	-28.50	-25.32	-16.63	-3.88	5.79	9.58	7.51	1.54	-8.31	-19.63	-25.00	-10.87
	STD DEV	9.63	9.33	7.53	8.89	6.28	5.04	4.48	4.27	4.29	6.39	8.11	8.54	15.71
850 MB TEMP	N OBS	830	755	800	776	800	774	797	794	773	797	765	800	9481
	MEAN	-18.23	-18.19	-17.26	-11.76	-3.88	3.54	5.89	3.74	-1.96	-9.25	-14.46	-17.20	-8.27
	STD DEV	9.19	9.07	7.27	6.82	5.73	4.87	4.37	4.80	5.48	6.39	7.27	8.47	11.24
NEAR SURFACE	N OBS	830	755	800	776	800	774	797	794	773	797	765	800	9481
TEMP GRAD	MEAN	0.0208	0.0181	0.0214	0.0190	0.0080	0.0053	0.0073	0.0069	0.0047	0.0023	0.0138	0.0158	0.0120
	STD DEV	0.0275	0.0255	0.0262	0.0259	0.0186	0.0135	0.0146	0.0147	0.0141	0.0148	0.0232	0.0238	0.0219
SURFACE-85 KPA	N OBS	830	755	800	776	800	774	797	794	773	797	765	800	9481
TEMP GRAD	MEAN	0.0072	0.0062	0.0062	0.0038	0.0000	-0.0017	-0.0027	-0.0028	-0.0027	-0.0007	0.0041	0.0062	0.0021
	STD DEV	0.0055	0.0056	0.0044	0.0042	0.0037	0.0027	0.0022	0.0021	0.0026	0.0036	0.0048	0.0059	0.0050
SURF INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURRENCE	AVG %	74.20%	70.71%	77.04%	72.06%	55.20%	57.77%	61.49%	57.88%	50.27%	37.11%	66.21%	68.52%	62.44%
	STD DEV	10.29%	11.34%	12.43%	11.79%	10.05%	9.12%	8.41%	11.12%	13.37%	9.31%	8.82%	10.83%	15.32%
UPP INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
OCCURRENCE	AVG %	20.51%	26.78%	20.59%	24.35%	27.71%	24.07%	11.79%	9.23%	10.22%	25.58%	25.61%	24.99%	20.97%
	STD DEV	10.40%	10.54%	11.87%	11.60%	11.49%	9.55%	5.60%	6.32%	6.58%	11.28%	9.72%	10.03%	11.73%
NO INVERSION	N MTHS	27	27	26	26	26	26	26	26	26	26	26	26	314
	AVG %	5.28%	2.50%	2.37%	3.59%	17.09%	18.15%	26.72%	32.89%	39.51%	37.31%	8.18%	6.51%	16.59%
	STD DEV	7.62%	3.60%	3.42%	4.80%	10.49%	9.44%	8.93%	9.74%	11.09%	14.51%	5.19%	5.84%	15.99%

STATISTICAL SUMMARY FOR UPPER AIR DATA

FORT SMITH A (1960-1987)

TIME - 00 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	585	557	580	565	586	563	588	552	561	579	566	585	6867
	MEAN	-22.80	-18.03	-7.56	4.15	13.29	18.63	20.74	19.23	11.71	2.91	-6.96	-19.75	0.96
	STD DEV	8.59	10.97	8.17	7.92	6.63	5.12	4.57	5.41	5.01	5.49	7.71	9.84	17.16
850 MB TEMP	N OBS	585	557	580	565	586	563	588	552	561	579	566	585	6867
	MEAN	-18.56	-14.40	-12.11	-4.76	1.94	7.08	9.21	7.90	1.80	-2.79	-9.29	-14.22	-3.98
	STD DEV	9.44	9.38	7.55	7.14	6.20	4.72	4.04	5.08	5.12	5.86	8.14	9.24	11.52
NEAR SURFACE	N OBS	585	557	580	565	586	563	588	552	561	579	566	585	6867
TEMP GRAD	MEAN	0.0033	-0.0050	-0.0091	-0.0097	-0.0110	-0.0108	-0.0099	-0.0036	-0.0092	-0.0085	-0.0013	0.0053	-0.0050
	STD DEV	0.0186	0.0092	0.0027	0.0029	0.0044	0.004*	0.0053	0.0043	0.0036	0.0071	0.0120	0.0186	0.0113
SURFACE-85 KPA	N OBS	585	557	580	565	586	563	588	552	561	579	566	585	6867
TEMP GRAD	MEAN	0.0052	0.0015	-0.0039	-0.0074	-0.0092	-0.0091	-0.0092	-0.0091	-0.0080	-0.0045	-0.0023	0.0046	-0.0041
	STD DEV	0.0254	0.0046	0.0034	0.0024	0.0016	0.0016	0.0016	0.0015	0.0021	0.0032	0.0040	0.0051	0.0083
SURF INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
OCCURRENCE	AVG %	36.55%	13.29%	0.85%	1.05%	0.85%	1.58%	2.38%	1.64%	1.05%	5.48%	24.78%	40.26%	11.07%
	STD DEV	8.67%	14.14%	1.83%	1.56%	1.77%	2.26%	2.30%	1.95%	1.93%	4.90%	10.67%	13.23%	16.12%
UPP INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
OCCURRENCE	AVG %	56.11%	62.34%	20.59%	1.77%	0.02%	0.16%	0.02%	0.18%	0.53%	10.09%	38.75%	50.23%	20.32%
	STD DEV	9.42%	14.04%	12.61%	2.99%	0.02%	0.74%	0.08%	0.74%	1.22%	9.04%	11.77%	14.61%	25.25%
NO INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
	AVG %	7.33%	24.37%	78.55%	97.17%	99.15%	98.25%	97.62%	98.18%	98.39%	83.65%	37.03%	9.41%	68.62%
	STD DEV	5.31%	14.15%	13.46%	3.66%	1.77%	2.26%	2.30%	1.97%	2.02%	8.14%	9.74%	5.77%	37.11%

FORT SMITH A (1960-1987)

TIME - 12 Z

	MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
SURFACE TEMP	N OBS	586	556	583	567	587	564	588	555	567	584	564	585	6886
	MEAN	-24.84	-23.25	-16.61	-5.08	3.37	8.82	10.79	9.32	4.25	-1.33	-11.87	-21.73	-5.72
	STD DEV	9.62	11.53	9.08	7.70	5.26	4.03	3.60	4.34	4.07	4.80	8.14	9.48	14.83
850 MB TEMP	N OBS	586	556	583	567	587	564	588	555	567	584	564	585	6886
	MEAN	-18.56	-14.27	-12.39	-5.00	1.21	6.02	8.18	7.07	1.37	-2.88	-10.18	-14.89	-4.37
	STD DEV	9.62	9.46	7.42	7.03	6.24	4.91	3.90	5.22	5.42	6.27	8.13	8.67	11.24
NEAR SURFACE	N OBS	586	556	583	567	587	564	588	555	567	584	564	585	6886
TEMP GRAD	MEAN	0.0127	0.0191	0.0251	0.0175	0.0136	0.0163	0.0238	0.0236	0.0130	0.0071	0.0057	0.0113	0.0157
	STD DEV	0.0275	0.0329	0.0364	0.0286	0.0242	0.0245	0.0285	0.0280	0.0237	0.0218	0.0213	0.0291	0.0282
SURFACE-85 KPA	N OBS	586	556	583	567	587	564	588	555	567	584	564	585	6886
TEMP GRAD	MEAN	0.0071	0.0061	0.0036	0.0001	-0.0018	-0.0023	-0.0021	-0.0018	-0.0024	-0.0013	0.0014	0.0061	0.0011
	STD DEV	0.0055	0.0058	0.0029	0.0030	0.0026	0.0024	0.0025	0.0027	0.0031	0.0038	0.0046	0.0053	0.0053
SURF INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
OCCURRENCE	AVG %	50.39%	57.35%	63.11%	63.29%	58.75%	63.90%	75.35%	77.87%	60.01%	43.05%	38.82%	43.12%	57.89%
	STD DEV	12.15%	16.05%	8.98%	9.82%	10.69%	7.72%	8.81%	7.70%	9.87%	12.62%	9.02%	14.05%	15.94%
UPP INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
OCCURRENCE	AVG %	43.47%	37.92%	30.18%	21.55%	18.24%	12.63%	5.78%	4.87%	9.68%	17.11%	34.68%	49.67%	23.98%
	STD DEV	12.50%	14.93%	8.20%	7.14%	6.11%	6.00%	5.59%	3.62%	4.94%	9.23%	9.62%	15.62%	17.25%
NO INVERSION	N MTHS	19	20	19	19	19	19	19	18	19	19	19	19	228
	AVG %	6.14%	4.73%	6.71%	15.17%	23.01%	23.19%	18.87%	17.26%	30.31%	39.25%	26.49%	7.20%	18.14%
	STD DEV	4.19%	5.25%	4.00%	8.23%	8.94%	6.71%	6.94%	7.88%	10.21%	10.80%	8.47%	6.33%	12.87%

APPENDIX 3: STATISTICS OF TREND ANALYSIS OF SURFACE AIR TEMPERATURE

TREND ANALYSIS: AIR TEMPERATURE
Fort Chipewyan A (1966-)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-62.02	-27.80	-17.53	-3.696	8.2618	14.064	11.697	15.251	1.4763	-1.137	-5.390	-34.42	-7.417
Std Err of Y Est	4.1715	4.8831	2.9246	3.0982	2.1499	1.2923	1.2536	2.0532	1.8182	1.6945	4.0533	4.8809	1.1172
R Squared	0.3419	0.0171	0.0197	0.0084	0.0000	0.0000	0.0764	0.0007	0.0774	0.0122	0.0111	0.0522	0.1337
No. of Observations	19	20	20	20	20	20	20	20	20	19	20	19	17
Degrees of Freedom	17	18	18	18	18	18	18	18	18	17	18	17	15
X Coefficient(s)	0.4855	0.1062	0.0682	0.0469	0.0025	-0.000	0.0593	-0.009	0.0866	0.0305	-0.070	0.1841	0.0675
Std Err of Coef.	0.1633	0.1893	0.1134	0.1201	0.0833	0.0501	0.0486	0.0796	0.0705	0.0663	0.1571	0.1902	0.0443

TREND ANALYSIS: AIR TEMPERATURE
Fort Good Hope (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-29.51	-31.45	-15.80	-12.01	3.0040	10.136	14.072	13.023	4.0949	-1.276	-13.27	-26.67	-7.469
Std Err of Y Est	4.5541	3.9967	3.4907	2.6791	1.9192	1.5189	0.9929	1.8631	1.6207	2.5664	3.2524	3.8061	0.8244
R Squared	0.0016	0.0151	0.0638	0.0252	0.0074	0.1188	0.1154	0.0008	0.0145	0.0776	0.1111	0.0030	0.0039
No. of Observations	32	31	32	34	34	32	31	32	32	31	31	31	24
Degrees of Freedom	30	29	30	32	32	30	29	30	30	29	29	29	22
X Coefficient(s)	-0.018	0.0473	-0.085	0.0407	0.0157	0.0535	0.0341	-0.005	0.0196	-0.074	-0.118	-0.021	-0.004
Std Err of Coef.	0.0762	0.0709	0.0600	0.0448	0.0321	0.0255	0.0175	0.0340	0.0298	0.0479	0.0621	0.0710	0.0163

Fort Good Hope (1971-)

Constant	-107.7	-134.9	-20.82	-30.57	14.613	35.686	9.9214	1.5571	-40.01	13.907	-47.08	42.078	-27.19
Std Err of Y Est	3.6452	3.7092	2.9684	3.0362	2.7597	1.5573	1.1854	1.5496	1.8868	2.8760	3.4748	2.7418	1.4542
R Squared	0.4109	0.4537	0.0005	0.0671	0.0200	0.1919	0.0490	0.0498	0.3776	0.0586	0.0527	0.4110	0.0957
No. of Observations	9	7	7	9	9	8	7	7	7	7	7	7	5
Degrees of Freedom	7	5	5	7	7	6	5	5	5	5	5	5	3
X Coefficient(s)	1.04	1.4285	-0.028	0.2783	-0.135	-0.286	0.0928	0.15	0.6214	-0.262	0.3484	-0.967	0.2591
Std Err of Coef.	0.4705	0.7009	0.5609	0.3919	0.3562	0.2403	0.1829	0.2928	0.3565	0.5057	0.6566	0.5181	0.4596

TREND ANALYSIS: AIR TEMPERATURE
Fort Liard (1973-)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-62.91	-25.64	-30.23	2.5591	5.2802	5.2413	7.5153	5.6104	10.367	-3.119	-2.924	-71.22	-9.892
Std Err of Y Est	6.1959	5.8465	4.3212	2.6292	1.7886	0.9434	1.2564	1.1015	1.6199	2.5074	5.3608	4.9774	1.0734
R Squared	0.1231	0.0047	0.0534	0.0003	0.0141	0.2399	0.1296	0.1749	0.0006	0.0080	0.0146	0.2760	0.1751
No. of Observations	13	13	14	14	13	14	13	15	15	15	14	13	9
Degrees of Freedom	11	11	12	12	11	12	11	13	13	13	12	11	7
X Coefficient(s)	0.5108	0.0886	0.2358	-0.011	0.0527	0.1217	0.1192	0.1092	-0.008	0.0485	-0.135	0.6355	0.1049
Std Err of Coef.	0.4110	0.3878	0.2864	0.1743	0.1325	0.0625	0.0931	0.0858	0.0968	0.1498	0.3209	0.3103	0.0860

TREND ANALYSIS: AIR TEMPERATURE
Fort Resolution A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-27.91	-25.35	-19.15	-8.044	5.3050	11.124	16.162	15.093	7.6263	-0.424	-11.63	-22.86	-5.938
Std Err of Y Est	4.1523	4.6543	3.5649	3.7924	2.1113	1.8791	1.3500	1.8685	1.6681	2.2157	3.5054	3.8029	1.1276
R Squared	0.0162	0.0167	0.0263	0.0448	0.0029	0.0271	0.0105	0.0233	0.0022	0.0027	0.0022	0.0063	0.1238
No. of Observations	46	47	44	46	45	47	44	45	46	45	45	42	35
Degrees of Freedom	44	45	42	44	43	45	42	43	44	43	43	40	33
X Coefficient(s)	0.0332	0.0371	0.0382	0.0505	0.0072	0.0170	-0.008	-0.018	-0.004	0.0071	0.0104	0.0195	0.0312
Std Err of Coef.	0.0390	0.0424	0.0359	0.0352	0.0204	0.0151	0.0129	0.0182	0.0156	0.0209	0.0334	0.0367	0.0144

Fort Resolution A (1971-)

Constant	-55.52	-48.66	-14.18	0.8180	28.541	23.195	14.793	24.901	3.4458	4.7635	-11.94	-26.48	-21.63
Std Err of Y Est	4.3330	4.8295	3.7750	3.8193	2.6990	1.0560	1.6404	1.7490	1.8142	2.1861	3.9969	3.1022	1.3397
R Squared	0.2063	0.1251	0.0011	0.0069	0.2251	0.3236	0.0009	0.1667	0.0196	0.0335	0.0004	0.0076	0.4160
No. of Observations	12	14	11	13	12	14	11	11	13	11	12	10	5
Degrees of Freedom	10	12	9	11	10	12	9	9	11	9	10	8	3
X Coefficient(s)	0.3936	0.3340	-0.026	-0.054	-0.277	-0.131	0.0079	-0.146	0.0453	-0.064	0.0158	0.0510	0.2471
Std Err of Coef.	0.2426	0.2549	0.2616	0.1965	0.1629	0.0546	0.0866	0.1081	0.0965	0.1146	0.2292	0.2050	0.1690

TREND ANALYSIS: AIR TEMPERATURE
Fort Simpson A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-59.58	-30.16	-20.70	-7.720	6.4383	12.248	14.277	16.214	0.9841	-0.728	-18.31	-34.44	-10.12
Std Err of Y Est	4.7551	4.6586	3.4198	3.2886	1.8882	0.9324	1.2324	1.3515	2.0553	2.2432	3.8188	3.7615	1.0538
R Squared	0.3051	0.0257	0.0284	0.0298	0.0110	0.0590	0.0351	0.0231	0.0833	0.0025	0.0035	0.0851	0.2477
No. of Observations	24	24	24	24	24	24	24	24	24	24	24	24	24
Degrees of Freedom	22	22	22	22	22	22	22	22	22	22	22	22	22
X Coefficient(s)	0.4358	0.1048	0.0809	0.0797	0.0276	0.0323	0.0325	-0.028	0.0856	-0.015	0.0314	0.1373	0.0836
Std Err of Coef.	0.1402	0.1373	0.1008	0.0969	0.0556	0.0274	0.0363	0.0398	0.0606	0.0661	0.1126	0.1109	0.0310

Fort Simpson A (1971-)

Constant	-67.68	-36.88	-27.15	-2.191	14.471	16.493	15.953	19.364	3.4147	-5.910	-16.65	-55.74	-11.87
Std Err of Y Est	5.0045	4.9279	2.8182	3.4700	2.1387	0.8658	1.2914	1.3436	2.1291	2.3859	4.1956	3.6108	1.2139
R Squared	0.2383	0.0378	0.0795	0.0002	0.0295	0.0144	0.0025	0.0636	0.0182	0.0111	0.0001	0.2500	0.1694
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.5367	0.1875	0.1588	0.0105	-0.071	-0.020	0.0125	-0.067	0.0558	0.0485	0.0100	0.3997	0.1051
Std Err of Coef.	0.2477	0.2439	0.1395	0.1717	0.1058	0.0428	0.0639	0.0665	0.1054	0.1181	0.2077	0.1787	0.0601

TREND ANALYSIS: AIR TEMPERATURE
Fort Smith A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-32.96	-26.06	-15.34	-8.846	4.7403	11.680	15.585	14.936	8.0185	1.5715	-11.10	-23.59	-5.893
Std Err of Y Est	4.6956	4.1837	3.5605	4.0041	1.9496	1.5141	1.0557	1.6539	1.6949	2.1710	3.9386	4.5051	1.0177
R Squared	0.0739	0.0790	0.0046	0.0979	0.0861	0.0511	0.0090	0.0085	0.0014	0.0117	0.0011	0.0082	0.1969
No. of Observations	42	44	44	44	44	44	44	44	45	45	44	44	42
Degrees of Freedom	40	42	42	42	42	42	42	42	43	43	42	42	40
X Coefficient(s)	0.1064	0.0942	0.0186	0.1015	0.0460	0.0270	0.0077	-0.011	-0.004	-0.017	-0.010	0.0316	0.0407
Std Err of Coef.	0.0595	0.0496	0.0422	0.0475	0.0231	0.0179	0.0125	0.0197	0.0194	0.0249	0.0463	0.0534	0.0129

Fort Smith A (1971-)

Constant	-64.00	-37.98	-23.15	-5.155	18.731	23.508	14.332	17.035	1.3590	-0.521	-8.180	-49.77	-9.316
Std Err of Y Est	5.0307	5.3207	2.9470	3.5207	2.1112	0.7921	1.2921	2.0389	1.9616	1.8723	4.2325	4.4696	1.2511
R Squared	0.2137	0.0435	0.0457	0.0074	0.0876	0.3866	0.0085	0.0097	0.0439	0.0007	0.0070	0.1467	0.1112
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.5029	0.2176	0.1237	0.0583	-0.125	-0.120	0.0230	-0.038	0.0806	0.0098	-0.068	0.3553	0.0848
Std Err of Coef.	0.2490	0.2634	0.1459	0.1743	0.1045	0.0392	0.0639	0.1009	0.0971	0.0926	0.2095	0.2212	0.0619

TREND ANALYSIS: AIR TEMPERATURE
Hay River A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-28.36	-26.97	-14.92	-9.265	3.0456	9.4034	15.140	15.072	8.2133	1.6329	-10.43	-25.58	-5.665
Std Err of Y Est	4.9821	4.3369	3.3602	4.0021	2.2982	1.4757	1.0110	1.5855	1.7144	2.0002	4.0615	4.2082	1.0687
R Squared	0.0226	0.0515	0.0024	0.0583	0.0467	0.0939	0.0099	0.0092	0.0000	0.0051	0.0034	0.0415	0.1154
No. of Observations	44	44	43	44	42	44	44	44	44	44	43	43	40
Degrees of Freedom	42	42	41	42	40	42	42	42	42	42	41	41	38
X Coefficient(s)	0.0583	0.0778	-0.012	0.0766	0.0394	0.0365	0.0078	-0.011	0.0002	-0.011	-0.018	0.0689	0.0314
Std Err of Coef.	0.0591	0.0514	0.0410	0.0475	0.0281	0.0175	0.0120	0.0188	0.0203	0.0237	0.0499	0.0517	0.0141

Hay River A (1971-)

Constant	-63.12	-39.73	-25.18	-1.648	17.498	18.139	19.813	18.350	4.5965	-0.222	-8.024	-50.43	-9.185
Std Err of Y Est	5.2536	5.4271	2.8265	4.0244	2.5816	0.7147	1.2560	1.6655	2.0474	1.8197	4.4446	4.0762	1.2858
R Squared	0.2023	0.0494	0.0469	0.0003	0.0725	0.2165	0.0435	0.0272	0.0144	0.0012	0.0031	0.1869	0.0654
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.5073	0.2372	0.1223	-0.014	-0.138	-0.072	-0.051	-0.053	0.0475	0.0125	-0.047	0.3747	0.0767
Std Err of Coef.	0.2600	0.2686	0.1399	0.1992	0.1278	0.0353	0.0622	0.0824	0.1013	0.0900	0.2200	0.2018	0.0636

TREND ANALYSIS: AIR TEMPERATURE
High Level A (1971-)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-67.31	-32.61	-18.86	1.6517	19.867	18.751	15.243	19.182	10.086	4.9855	0.7502	-42.67	-5.910
Std Err of Y Est	4.8324	5.1791	2.9721	3.0698	1.4807	0.6791	1.1962	1.5787	1.9335	1.7622	4.9645	4.6431	1.1725
R Squared	0.2821	0.0340	0.0330	0.0000	0.1698	0.1647	0.0021	0.0482	0.0039	0.0186	0.0288	0.0925	0.0611
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.5808	0.1865	0.1053	0.0026	-0.128	-0.057	0.0105	-0.068	-0.023	-0.046	-0.157	0.2843	0.0573
Std Err of Coef.	0.2392	0.2564	0.1471	0.1519	0.0733	0.0336	0.0592	0.0781	0.0957	0.0872	0.2457	0.2298	0.0580

TREND ANALYSIS: AIR TEMPERATURE
Inuvik A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-42.57	-33.28	-27.06	-11.63	0.3548	7.0470	13.555	13.040	-0.006	-7.480	-24.05	-33.89	-12.23
Std Err of Y Est	4.7851	4.1351	3.2788	3.3014	2.1049	1.7768	1.5641	2.0834	1.9341	3.0220	4.0539	3.8271	1.2181
R Squared	0.1099	0.0177	0.0087	0.0121	0.0057	0.0574	0.0000	0.0234	0.0452	0.0010	0.0080	0.0630	0.0607
No. of Observations	30	30	31	31	31	31	31	31	31	31	30	31	29
Degrees of Freedom	28	28	29	29	29	29	29	29	29	29	28	29	27
X Coefficient(s)	0.1877	0.0619	0.0333	-0.039	-0.017	0.0474	-0.000	-0.034	0.0455	-0.010	0.0403	0.1017	0.0354
Std Err of Coef.	0.1009	0.0872	0.0658	0.0662	0.0422	0.0356	0.0314	0.0418	0.0388	0.0606	0.0844	0.0728	0.0268

Inuvik A (1971-)

Constant	-43.85	-38.30	-39.45	-5.461	5.6909	2.4512	10.938	11.299	-2.420	-15.22	-11.46	-47.02	-13.73
Std Err of Y Est	5.8443	4.1554	2.9158	2.9524	2.6251	1.8144	1.6632	1.7160	2.2057	3.1884	4.9213	3.4641	1.3284
R Squared	0.0350	0.0252	0.1001	0.0405	0.0268	0.0851	0.0421	0.0010	0.0326	0.0194	0.0153	0.1355	0.0443
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.2063	0.1281	0.1885	-0.116	-0.083	0.1081	-0.066	-0.010	0.0778	0.0860	-0.117	0.2629	0.0548
Std Err of Coef.	0.2794	0.2057	0.1443	0.1461	0.1299	0.0898	0.0823	0.0849	0.1092	0.1578	0.2436	0.1715	0.0657

TREND ANALYSIS: AIR TEMPERATURE
Komakuk Beach A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-37.63	-30.50	-26.44	-14.24	-3.007	-1.473	5.1082	2.7801	-1.066	-8.205	-18.36	-20.35	-15.45
Std Err of Y Est	4.8396	4.0984	2.9776	2.7848	1.8355	1.1927	1.6155	1.7157	1.8974	2.9492	3.7279	3.6793	1.2952
R Squared	0.0709	0.0057	0.0033	0.0320	0.0264	0.1845	0.0262	0.0416	0.0111	0.0027	0.0002	0.0077	0.0522
No. of Observations	24	23	27	29	29	27	29	28	29	29	29	27	18
Degrees of Freedom	22	21	25	27	27	25	27	26	27	27	27	25	16
X Coefficient(s)	0.1722	0.0486	0.0087	-0.058	-0.036	0.0670	0.0305	0.0416	0.0232	-0.017	-0.007	-0.039	0.0534
Std Err of Coef.	0.1328	0.1135	0.0704	0.0618	0.0427	0.0281	0.0358	0.0390	0.0421	0.0654	0.0827	0.0901	0.0566

Komakuk Beach A (1971-)

Constant	-48.98	-68.18	-42.20	-11.45	-4.607	0.3289	9.7098	4.3480	-1.236	-11.90	-11.60	-43.33	-21.21
Std Err of Y Est	4.8126	2.9168	2.6451	2.2471	2.0649	1.4149	1.5049	1.7505	2.2216	3.2515	4.1591	3.7843	1.4701
R Squared	0.0981	0.4179	0.1342	0.0471	0.0019	0.0263	0.0089	0.0044	0.0037	0.0020	0.0134	0.1035	0.1099
No. of Observations	16	14	17	17	17	17	17	17	17	17	17	17	13
Degrees of Freedom	14	12	15	15	15	15	15	15	15	15	15	15	11
X Coefficient(s)	0.3149	0.5338	0.1997	-0.095	-0.017	0.0446	-0.027	0.0225	0.0262	0.0281	-0.093	0.2465	0.1270
Std Err of Coef.	0.2550	0.1818	0.1309	0.1112	0.1022	0.0700	0.0745	0.0866	0.1099	0.1609	0.2059	0.1873	0.1069

TREND ANALYSIS: AIR TEMPERATURE
Norman Wells A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-32.62	-27.87	-17.67	-8.809	3.9854	11.849	14.751	12.859	4.5639	-1.857	-14.54	-28.27	-7.316
Std Err of Y Est	4.9072	4.0129	3.3197	3.0549	1.9273	1.4466	1.0854	1.7267	1.6758	2.4854	3.9031	3.8882	1.0477
R Squared	0.0387	0.0067	0.0075	0.0102	0.0278	0.0926	0.0867	0.0021	0.0394	0.0511	0.0386	0.0181	0.0473
No. of Observations	44	44	44	44	45	45	45	45	45	45	45	45	44
Degrees of Freedom	42	42	42	42	43	43	43	43	43	43	43	43	42
X Coefficient(s)	0.0758	0.0253	-0.022	0.0239	0.0245	0.0347	0.0247	0.0060	0.0255	-0.043	-0.058	0.0398	0.0179
Std Err of Coef.	0.0582	0.0476	0.0394	0.0362	0.0221	0.0166	0.0122	0.0198	0.0192	0.0285	0.0448	0.0446	0.0124

Norman Wells A (1971-)

Constant	-57.41	-34.57	-30.92	-4.736	10.534	17.135	17.534	16.000	3.925	-10.31	-8.405	-58.09	-11.61
Std Err of Y Est	5.2831	4.7249	2.3785	2.8455	2.5266	1.2139	1.3638	1.3403	2.0357	2.7680	4.4995	3.8648	1.1838
R Squared	0.1336	0.0151	0.0907	0.0027	0.0121	0.0157	0.0010	0.0160	0.0087	0.0154	0.0225	0.2583	0.0957
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.3962	0.1125	0.1441	-0.025	-0.053	-0.029	-0.008	-0.032	0.0357	0.0654	-0.131	0.4147	0.0742
Std Err of Coef.	0.2615	0.2339	0.1177	0.1409	0.1250	0.0600	0.0675	0.0663	0.1007	0.1370	0.2227	0.1914	0.0564

TREND ANALYSIS: AIR TEMPERATURE
Shingle Point A (All Data.

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-41.26	-39.50	-26.76	-10.24	-2.344	2.7104	11.063	10.261	-0.067	-7.899	-18.76	-28.33	-11.71
Std Err of Y Est	4.6565	4.3802	3.4067	3.0091	2.2344	1.8215	1.6333	2.2399	1.9976	2.8260	3.9550	3.3552	1.3594
R Squared	0.1305	0.0920	0.0036	0.0726	0.0169	0.0374	0.0001	0.0085	0.0197	0.0013	0.0001	0.0101	0.0102
No. of Observations	24	22	27	29	29	30	30	29	31	30	28	28	19
Degrees of Freedom	22	20	25	27	27	28	28	27	29	28	26	26	17
X Coefficient(s)	0.2179	0.1753	0.0235	-0.095	-0.033	0.0388	-0.001	-0.022	0.0306	-0.011	-0.004	0.0378	0.0201
Std Err of Coef.	0.1198	0.1232	0.0782	0.0658	0.0486	0.0372	0.0340	0.0473	0.0401	0.0585	0.0874	0.0734	0.0480

Shingle Point A (1971-)

Constant	-54.83	-68.94	-43.01	-7.748	-3.333	-2.318	13.941	9.0031	-1.926	-10.08	-11.53	-44.72	-25.04
Std Err of Y Est	4.8922	3.4383	2.9759	2.7981	2.5400	1.7371	1.8261	1.9143	2.3080	3.0730	4.8151	3.1636	1.4733
R Squared	0.1434	0.3574	0.1320	0.0542	0.0019	0.0868	0.0138	0.0001	0.0156	0.0007	0.0116	0.1592	0.2109
No. of Observations	15	14	17	17	17	17	17	17	17	17	17	17	12
Degrees of Freedom	13	12	15	15	15	15	15	15	15	15	15	15	10
X Coefficient(s)	0.3898	0.5535	0.2225	-0.128	-0.021	0.1026	-0.037	-0.004	0.0556	0.0159	-0.096	0.2639	0.1934
Std Err of Coef.	0.2640	0.2142	0.1473	0.1384	0.1257	0.0860	0.0905	0.0947	0.1142	0.1521	0.2264	0.1566	0.1183

TREND ANALYSIS: AIR TEMPERATURE
Tuktoyaktuk (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-43.21	-41.80	-28.48	-16.85	-3.198	2.7440	11.319	9.4292	-0.417	-8.214	-23.44	-26.84	-14.97
Std Err of Y Est	4.0206	3.3693	2.9609	3.0692	2.2251	1.6290	1.7803	1.8146	1.9018	2.8045	3.4456	3.3930	1.2038
R Squared	0.1716	0.1654	0.0086	0.0003	0.0085	0.0353	0.0032	0.0012	0.0407	0.0003	0.0159	0.0054	0.1182
No. of Observations	27	26	30	30	30	30	30	30	30	30	30	30	24
Degrees of Freedom	25	24	28	28	28	28	28	28	28	28	28	28	22
X Coefficient(s)	0.2147	0.1857	0.0311	-0.006	-0.023	0.0347	-0.011	-0.007	0.0437	0.0055	0.0489	0.0279	0.0581
Std Err of Coef.	0.0943	0.0851	0.0624	0.0647	0.0469	0.0343	0.0375	0.0382	0.0401	0.0591	0.0726	0.0715	0.0338

Tuktoyaktuk (1971-)

Constant	-55.03	-68.86	-39.63	-10.93	5.4911	4.6318	20.158	12.382	-0.396	-12.54	-14.06	-45.85	-20.33
Std Err of Y Est	5.0800	3.0227	2.9303	2.7911	2.5362	1.8424	1.9256	1.4504	2.1790	3.0863	4.1707	3.2647	1.4204
R Squared	0.1140	0.3991	0.0808	0.0228	0.0689	0.0012	0.0981	0.0232	0.0113	0.0098	0.0072	0.1505	0.1183
No. of Observations	15	14	17	17	17	17	17	17	17	17	17	17	13
Degrees of Freedom	13	12	15	15	15	15	15	15	15	15	15	15	11
X Coefficient(s)	0.3649	0.5321	0.1656	-0.061	-0.132	0.0122	-0.121	-0.042	0.0448	0.0590	-0.068	0.2634	0.1266
Std Err of Coef.	0.2820	0.1884	0.1450	0.1361	0.1255	0.0912	0.0953	0.0718	0.1078	0.1527	0.2064	0.1616	0.1052

TREND ANALYSIS: AIR TEMPERATURE
Tungsten (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-62.85	-14.15	-17.73	-5.589	1.8729	13.387	8.0756	12.636	2.3629	-12.05	-2.082	-39.09	-20.37
Std Err of Y Est	5.6699	4.8951	2.8515	2.3634	1.3485	0.9730	0.9800	1.0339	1.3881	1.8705	4.6478	4.9821	0.7639
R Squared	0.2639	0.0044	0.0192	0.0003	0.0043	0.1155	0.1508	0.0707	0.0036	0.1444	0.0520	0.0833	0.4598
No. of Observations	19	19	20	17	17	19	19	19	20	20	22	20	7
Degrees of Freedom	17	17	18	15	15	17	17	17	18	18	20	18	5
X Coefficient(s)	0.5291	-0.050	0.0613	0.0075	0.0143	-0.057	0.0657	-0.047	0.0135	0.1039	-0.163	0.2472	0.2030
Std Err of Coef.	0.2142	0.1855	0.1033	0.1026	0.0560	0.0383	0.0378	0.0418	0.0513	0.0598	0.1561	0.1931	0.0984

Tungsten (1971-)

Constant	-71.39	-14.84	-21.09	-2.872	1.9726	13.082	9.3687	12.940	1.3694	-16.29	-12.21	-49.46	-20.37
Std Err of Y Est	6.0487	5.4292	2.4471	2.4157	1.4455	1.0217	0.9883	1.0657	1.4985	1.8976	4.7739	4.8531	0.7639
R Squared	0.2313	0.0016	0.0450	0.0039	0.0023	0.0581	0.0186	0.0591	0.0083	0.1925	0.0016	0.1393	0.4598
No. of Observations	15	15	18	18	15	15	18	17	18	15	17	17	7
Degrees of Freedom	13	13	14	14	13	13	14	15	14	13	15	15	5
X Coefficient(s)	0.6343	-0.042	0.1018	-0.028	0.0130	-0.053	0.0253	-0.051	0.0280	0.1567	-0.037	0.3748	0.2030
Std Err of Coef.	0.3207	0.2971	0.1252	0.1210	0.0754	0.0594	0.0491	0.0527	0.0757	0.0990	0.2363	0.2402	0.0984

TREND ANALYSIS: AIR TEMPERATURE
Wrigley A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-34.57	-24.07	-13.46	-4.979	7.0974	13.933	16.206	14.715	7.4808	0.6879	-15.64	-29.05	-6.154
Std Err of Y Est	4.4185	3.9371	2.9931	2.9805	1.4864	1.2187	1.0614	1.7177	1.7877	2.5402	4.0702	3.9904	1.0256
R Squared	0.0516	0.0006	0.0289	0.0074	0.0004	0.0008	0.0004	0.0151	0.0075	0.0819	0.0068	0.0282	0.0232
No. of Observations	32	39	38	38	38	41	38	40	43	35	41	32	24
Degrees of Freedom	30	37	36	34	36	39	36	38	41	33	39	30	22
X Coefficient(s)	0.0930	-0.008	-0.042	0.0207	0.0025	0.0027	0.0019	-0.016	-0.012	-0.060	-0.027	0.0580	0.0156
Std Err of Coef.	0.0727	0.0527	0.0413	0.0411	0.0198	0.0156	0.0144	0.0214	0.0215	0.0353	0.0522	0.0621	0.0219

Wrigley A (1971-)

Constant	-78.42	-25.20	-22.97	-2.069	11.010	18.508	16.280	16.110	8.4063	-9.829	-12.52	-60.47	-21.37
Std Err of Y Est	2.9531	4.9499	2.0035	3.3296	1.9557	1.1453	1.4120	1.3541	2.1671	2.4720	4.6473	3.2656	1.0536
R Squared	0.6464	0.0000	0.0422	0.0009	0.0156	0.0562	0.0002	0.0186	0.0001	0.0359	0.0050	0.4684	0.6739
No. of Observations	10	15	13	13	15	16	12	13	16	11	17	8	5
Degrees of Freedom	8	13	11	11	13	14	10	11	14	9	15	6	3
X Coefficient(s)	0.5649	0.0060	0.0776	-0.016	-0.044	-0.052	0.0037	-0.032	0.0045	0.0744	-0.053	0.4557	0.2148
Std Err of Coef.	0.1728	0.2631	0.1114	0.1700	0.0974	0.0578	0.0781	0.0714	0.1127	0.1285	0.2302	0.1981	0.0862

TREND ANALYSIS: AIR TEMPERATURE
Yellowknife A (All Data)

Regression Output:	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
Constant	-30.65	-29.73	-18.19	-12.29	1.2955	10.190	14.992	14.900	7.4541	0.2407	-12.89	-25.35	-8.826
Std Err of Y Est	4.5081	4.2162	3.2727	3.7499	2.3783	1.6168	1.1393	1.5693	1.6042	2.3503	3.8698	4.3799	1.1497
R Squared	0.0153	0.0482	0.0001	0.0779	0.0605	0.0844	0.0478	0.0132	0.0055	0.0207	0.0045	0.0045	0.0543
No. of Observations	45	45	45	45	45	45	45	45	45	45	45	45	45
Degrees of Freedom	43	43	43	43	43	43	44	44	44	44	44	44	43
X Coefficient(s)	0.0423	0.0715	-0.003	0.0820	0.0529	0.0369	0.0188	-0.013	-0.008	-0.025	-0.019	0.0218	0.0207
Std Err of Coef.	0.0517	0.0484	0.0375	0.0430	0.0272	0.0185	0.0126	0.0174	0.0178	0.0261	0.0431	0.0486	0.0131

Yellowknife A (1971-)

Constant	-63.31	-42.57	-25.78	-5.347	18.341	25.912	18.113	18.072	4.9350	-4.387	-5.898	-51.90	-9.486
Std Err of Y Est	4.8207	5.3515	2.8379	3.8231	2.7254	1.1014	1.3981	1.5920	1.8886	2.2089	4.3823	4.5446	1.3840
R Squared	0.1998	0.0497	0.0349	0.0000	0.0821	0.3640	0.0053	0.0294	0.0049	0.0065	0.0147	0.1390	0.0474
No. of Observations	17	17	17	17	17	17	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15	15	15	15	15	15	15
X Coefficient(s)	0.4620	0.2348	0.0963	-0.000	-0.156	-0.159	-0.019	-0.053	0.0252	0.0343	-0.102	0.3502	0.0592
Std Err of Coef.	0.2385	0.2649	0.1308	0.1793	0.1349	0.0545	0.0692	0.0786	0.0925	0.1093	0.2169	0.2249	0.0685

APPENDIX 4: STATISTICS OF TREND ANALYSIS OF UPPER AIR TEMPERATURE

TIME TREND STATISTICS FOR UPPER AIR DATA
STATION: FORT SMITH A

LEVEL: SURFACE
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-68.5121	-50.8931	-9.37180	4.930690	14.56018	23.19531	17.82947	16.93588	8.219611	7.263388	3.056530	-22.5492	1.001072
Std Err of Y Est	4.505245	7.294792	2.901803	3.886734	2.881582	1.383052	1.525782	2.439171	2.108287	1.846133	3.648335	4.709078	1.157041
R Squared	0.259649	0.119020	0.002097	0.000288	0.001378	0.057171	0.032329	0.004579	0.038998	0.027926	0.005382	0.001105	0.000025
No. of Observation	19	20	19	19	19	19	19	18	19	19	19	19	17
Degrees of Freedom	17	18	17	17	17	17	17	16	17	17	17	17	15
X Coefficient(s)	0.460765	0.421973	0.022972	-0.01058	-0.01869	-0.05924	0.048156	0.030095	0.071383	-0.05403	-0.10864	0.027257	0.001124
Std Err of Coef.	0.188703	0.282879	0.121534	0.151089	0.108964	0.058346	0.063927	0.110814	0.088305	0.077328	0.152811	0.197241	0.057282

LEVEL: 85 KPA
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-83.2254	-18.1815	-14.8804	-2.67195	5.888022	10.21712	4.566072	4.718681	-1.43358	-3.66788	-0.81395	-14.9488	-5.37875
Std Err of Y Est	4.983555	8.184037	2.981902	3.292642	2.502452	1.516024	1.589685	2.431780	2.351270	1.711578	3.851843	4.886235	1.148579
R Squared	0.326201	0.000697	0.004222	0.002344	0.012075	0.023558	0.047225	0.008618	0.010574	0.031382	0.034641	0.002034	0.008784
No. of Observation	19	20	19	19	19	19	19	18	19	19	19	19	17
Degrees of Freedom	17	18	17	17	17	17	17	16	17	17	17	17	15
X Coefficient(s)	0.598833	0.022828	0.032722	-0.02756	-0.04778	-0.04088	0.060352	0.041978	0.041978	0.010919	-0.11982	0.024728	0.016092
Std Err of Coef.	0.208736	0.301026	0.124881	0.137913	0.104819	0.063499	0.065746	0.113477	0.090482	0.071890	0.152856	0.195449	0.056883

LEVEL: SURFACE
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-83.2899	-58.2596	-17.4429	-1.84441	6.542731	13.73355	7.620494	6.714223	5.689624	3.458133	1.939591	-22.8114	-5.73746
Std Err of Y Est	4.876200	8.779116	3.098345	2.893694	2.031222	1.237707	1.284581	1.983442	1.909723	1.491588	3.866891	4.904982	1.112354
R Squared	0.255237	0.126655	0.000417	0.007066	0.013718	0.081924	0.029527	0.000640	0.005140	0.006655	0.007203	0.000278	0.000072
No. of Observation	19	20	19	19	19	19	19	18	19	19	19	19	17
Degrees of Freedom	17	18	17	17	17	17	17	16	17	17	17	17	15
X Coefficient(s)	0.493112	0.425119	0.010937	-0.04216	-0.04137	-0.08385	0.038561	0.007745	-0.01874	-0.02344	-0.17923	0.014178	0.001822
Std Err of Coef.	0.204241	0.282882	0.129775	0.121211	0.085082	0.051841	0.053805	0.076480	0.063235	0.061219	0.161957	0.205447	0.059069

LEVEL: 85 KPA
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-83.7034	-17.8279	-16.6645	-3.48049	4.879288	8.500542	3.255480	4.863738	-2.46252	-4.01025	-0.48853	-13.5547	-6.06875
Std Err of Y Est	5.065577	5.018518	3.019970	3.142815	2.458027	1.497257	1.550494	2.430483	2.491685	1.705257	3.848280	4.803629	1.151773
R Squared	0.323292	0.003060	0.011392	0.001365	0.011229	0.015270	0.047936	0.004213	0.013194	0.005834	0.034823	0.000350	0.009719
No. of Observation	19	20	19	19	19	19	19	18	19	19	19	19	17
Degrees of Freedom	17	18	17	17	17	17	17	16	17	17	17	17	15
X Coefficient(s)	0.604684	0.045748	0.055987	-0.02007	-0.04520	-0.03220	0.063959	0.028729	0.049752	0.022581	-0.12566	-0.01456	0.021874
Std Err of Coef.	0.212173	0.194629	0.126492	0.131838	0.102871	0.062713	0.065121	0.110418	0.104385	0.071425	0.181189	0.188836	0.057021

TIME TREND STATISTICS FOR UPPER AIR DATA
STATION: INUVIK A

LEVEL: SURFACE
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-43.3772	-33.7320	-19.1926	-3.66680	6.661644	10.63982	21.52583	18.50148	3.332873	0.619055	-19.1590	-32.5624	-7.51988
Std Err of Y Est	4.650919	3.793996	3.237158	3.043639	2.287231	1.781940	1.718599	2.218202	2.123245	2.878624	3.889598	3.745309	1.077430
R Squared	0.130699	0.044482	0.001792	0.056266	0.049911	0.040182	0.068282	0.043120	0.023211	0.056812	0.000004	0.044192	0.006812
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.222794	0.101107	-0.01757	-0.09520	-0.06715	0.048705	-0.05959	-0.06032	0.041928	-0.09050	0.001030	0.103165	0.011430
Std Err of Coef.	0.114918	0.093743	0.084647	0.079587	0.059808	0.046595	0.044939	0.058003	0.055520	0.075272	0.101708	0.097935	0.028173

LEVEL: 85 KPA
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-29.8746	-19.9996	-22.2514	-10.8423	-7.119058	3.824143	8.660100	7.436267	-3.22267	-4.02493	-16.4710	-23.9123	-9.67366
Std Err of Y Est	4.405621	3.756394	3.184492	2.987407	2.553562	1.728510	1.462516	1.882218	2.394269	3.050474	3.548280	4.030261	1.011243
R Squared	0.078110	0.003381	0.029296	0.000745	0.022670	0.000036	0.034127	0.046354	0.004878	0.023617	0.003945	0.021916	0.025466
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.188225	0.027685	0.070869	-0.01045	0.047523	-0.00133	-0.03521	-0.04694	0.021469	-0.09626	0.026826	0.077264	0.020950
Std Err of Coef.	0.108881	0.092883	0.083270	0.078117	0.059772	0.045196	0.038243	0.049459	0.058267	0.079788	0.092733	0.105369	0.026442

LEVEL: SURFACE
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-45.0878	-42.5028	-32.0841	-20.4794	-3.156130	2.406287	10.54369	8.966755	-3.45568	-4.34480	-22.5926	-32.8661	-14.0061
Std Err of Y Est	4.754235	3.678971	3.541625	3.622295	1.989474	1.542117	1.499378	1.726392	1.778457	2.912537	4.161886	3.572198	1.235496
R Squared	0.143648	0.134991	0.039819	0.012457	0.001493	0.051697	0.004553	0.001103	0.001932	0.022514	0.035788	0.049553	0.074243
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.240555	0.189301	0.092390	0.052359	-0.00984	0.046125	-0.01299	0.007359	0.068260	-0.05401	0.040879	0.104487	0.044820
Std Err of Coef.	0.117489	0.095842	0.092609	0.095158	0.052022	0.040324	0.039206	0.044594	0.046504	0.076185	0.108628	0.093429	0.032306

LEVEL: 85 KPA
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-29.8897	-19.3694	-21.8143	-11.3930	-7.75751	4.036372	8.987034	7.283884	-2.06342	-4.23114	-15.7044	-24.3778	-9.36013
Std Err of Y Est	3.787432	3.211956	2.972089	2.464272	1.694362	1.360184	1.581879	2.365581	3.035070	3.554235	4.064462	2.992968	
R Squared	0.083549	0.001149	0.022453	0.000175	0.027135	0.000931	0.055353	0.053523	0.000030	0.030111	0.001485	0.034023	0.015145
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.158217	0.015874	0.062358	-0.00503	0.052721	-0.00662	-0.04217	-0.04833	0.001822	-0.08850	0.017468	0.097716	0.015774
Std Err of Coef.	0.106913	0.093581	0.083986	0.077716	0.064437	0.044305	0.035567	0.041364	0.062360	0.078383	0.092939	0.106262	0.025965

TIME TREND STATISTICS FOR UPPER AIR DATA
STATION: NORMAN WELLS A

LEVEL: SURFACE
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-47.3459	-31.2701	-19.6956	-2.95086	3.745165	16.84326	19.90879	17.07305	4.844740	3.723227	-16.3081	-31.7838	-6.84771
Std Err of Y Est	4.952870	3.998057	3.388593	3.052557	2.354426	1.338038	1.231596	1.834637	2.166026	2.912581	3.985519	4.201592	1.121241
R Squared	0.173266	0.038142	0.018751	0.000008	0.055580	0.006047	0.000419	0.000521	0.059421	0.047342	0.000844	0.022737	0.104260
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.280119	0.098358	0.060006	0.001148	0.073167	0.013349	0.003231	0.004782	0.069742	-0.08317	-0.01476	0.062098	0.049003
Std Err of Coef.	0.122377	0.098785	0.088607	0.079820	0.061585	0.034935	0.032204	0.042743	0.056639	0.076180	0.103693	0.109855	0.029319

LEVEL: 85 KPA
TIME: 0 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-37.8020	-20.9328	-23.9004	-12.0245	-5.50676	8.269279	9.512384	9.889522	-3.12130	-2.72347	-15.4391	-24.2859	-9.67782
Std Err of Y Est	5.211454	5.254586	3.366976	3.146020	2.639006	1.369964	1.311979	1.359212	2.375854	2.878448	4.220074	4.490695	1.089963
R Squared	0.156660	0.011052	0.071666	0.010177	0.029615	0.022963	0.007185	0.056950	0.030135	0.011351	0.007469	0.042161	0.127585
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.277512	0.056628	0.120038	0.040865	0.059059	-0.02630	-0.01429	-0.04276	0.053850	-0.03951	0.046952	0.120592	0.053398
Std Err of Coef.	0.126766	0.129631	0.086042	0.082264	0.069036	0.035823	0.034336	0.035547	0.062125	0.075267	0.110349	0.117425	0.028531

LEVEL: SURFACE
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-46.3317	-36.5652	-31.9037	-15.8269	-3.08740	8.869939	10.80251	11.45185	0.409692	-0.26117	-16.2840	-32.3815	-12.4868
Std Err of Y Est	5.166546	4.995266	3.595592	3.395033	1.980174	1.464482	1.202087	1.524242	1.468467	2.555899	4.007943	4.318755	1.029273
R Squared	0.156080	0.034612	0.056697	0.013484	0.035260	0.000012	0.001215	0.038550	0.030169	0.048347	0.006974	0.022474	0.102490
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.275670	0.116866	0.115226	0.050847	0.048005	0.000670	0.005371	-0.03910	0.033630	-0.07379	-0.04112	0.063849	0.044558
Std Err of Coef.	0.128202	0.123439	0.094019	0.088776	0.051256	0.038294	0.031433	0.039859	0.038921	0.066833	0.104602	0.112676	0.026914

LEVEL: 85 KPA
TIME: 12 Z

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Constant	-39.2106	-21.3721	-24.7633	-14.1327	-6.25791	7.537710	8.074259	9.903366	-3.42503	-2.39093	-16.8388	-25.1675	-10.4711
Std Err of Y Est	5.226211	5.135679	3.500335	3.100920	2.621725	1.411955	1.461236	1.467484	2.353879	2.872990	4.052514	4.629146	1.101966
R Squared	0.171955	0.014471	0.082951	0.030132	0.036195	0.019323	0.000539	0.069768	0.030628	0.015712	0.015163	0.049147	0.156476
No. of Observation	27	27	26	26	26	26	26	26	26	26	26	26	26
Degrees of Freedom	25	25	24	24	24	24	24	24	24	24	24	24	24
X Coefficient(s)	0.294338	0.076863	0.134886	0.070017	0.065084	-0.02538	-0.00422	-0.05148	0.053599	-0.04643	0.064417	0.134619	0.061259
Std Err of Coef.	0.129180	0.126893	0.091529	0.081085	0.068555	0.036920	0.038209	0.038372	0.061551	0.075125	0.105956	0.121046	0.028015

APPENDIX 5: STATISTICS OF TREND ANALYSIS OF SNOW DEPTH

TREND ANALYSIS: SNOW DEPTH
Fort Chipewyan A (1966-)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	156.74	226.60	202.00	51.945	82.855
Std Err of Y Est	15.530	19.715	24.321	8.1365	11.122
R Squared	0.1867	0.2624	0.1614	0.0777	0.0296
No. of Observations	16	17	17	16	15
Degrees of Freedom	14	15	15	14	13
X Coefficient(s)	-1.426	-2.254	-2.046	-0.479	-0.392
Std Err of Coef.	0.7951	0.9780	1.2041	0.4412	0.6233

TREND ANALYSIS: SNOW DEPTH
Fort Good Hope (All Data

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	86.094	87.839	83.583	46.616	36.962	63.661	82.822
Std Err of Y Est	19.685	24.783	27.820	25.826	13.726	16.276	18.482
R Squared	0.2697	0.2848	0.2226	0.0713	0.2662	0.2971	0.1149
No. of Observations	28	27	25	27	24	25	23
Degrees of Freedom	26	25	23	25	22	23	21
X Coefficient(s)	-0.47	-0.803	-0.285	-0.225	-0.313	-0.822	-0.513
Std Err of Coef.	0.3139	0.3949	0.4435	0.4117	0.2187	0.2594	0.2942

Fort Good Hope (1971-

Constant	47.382	88.781	-0.843	53.691	84.802	159.3	53.111
Std Err of Y Est	13.318	23.572	16.777	30.372	13.169	11.742	13.756
R Squared	0.0007	0.0074	0.0003	0.0023	0.1351	0.3832	0.0254
No. of Observations	12	11	10	11	10	9	12
Degrees of Freedom	10	9	8	9	8	7	10
X Coefficient(s)	0.0674	-0.434	0.7433	-0.276	-0.873	-1.67	-0.169
Std Err of Coef.	0.8002	1.5541	1.4150	1.8921	0.7813	0.8544	0.8041

TREND ANALYSIS: SNOW DEPTH
Fort Liard (1973-

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	165.17	-102.9	261.65	-51.55	119.61
Std Err of Y Est	19.366	10.542	25.853	13.180	16.739
R Squared	0.1225	0.4219	0.1345	0.1077	0.1001
No. of Observations	10	8	11	10	11
Degrees of Freedom	8	6	9	8	9
X Coefficient(s)	-1.532	1.9066	-2.685	0.8886	-1.144
Std Err of Coef.	1.4496	0.9111	2.2707	0.9043	1.1437

TREND ANALYSIS: SNOW DEPTH
Fort Resolution A (All Data

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	83.280	95.194	88.726	33.244	78.467
Std Err of Y Est	13.295	14.923	19.776	16.889	12.892
R Squared	0.0167	0.1522	0.0554	0.0221	0.1226
No. of Observations	31	31	30	29	29
Degrees of Freedom	29	29	28	27	27
X Coefficient s	-0.175	-0.836	-0.820	0.0199	-0.812
Std Err of Coef.	0.2487	0.2791	0.3814	0.3157	0.2411

Fort Resolution A (197

Constant	270.09	265.84	148.70	211.51	269.61
Std Err of Y Est	4.6677	5.1917	10.736	6.6916	5.2957
R Squared	0.8748	0.8102	0.2187	0.5737	0.9515
No. of Observations	8	8	7	8	8
Degrees of Freedom	6	6	5	4	3
X Coefficient(s)	-2.961	-4.048	-1.441	-2.436	-3.095
Std Err of Coef.	0.4577	0.7999	1.2181	1.0371	0.4032

TREND ANALYSIS: SNOW DEPTH
Fort Simpson A (All Data)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	75.775	79.671	59.859	19.776	34.334
Std Err of Y Est	13.978	15.328	20.449	12.024	13.959
R Squared	0.0395	0.0236	0.0008	0.0034	0.0003
No. of Observations	24	24	24	23	24
Degrees of Freedom	22	22	22	21	22
X Coefficient(s)	-0.392	-0.331	-0.064	0.0964	0.0369
Std Err of Coef.	0.4121	0.4520	0.6030	0.3565	0.4116

Fort Simpson A (1971-

Constant	87.234	85.822	122.18	14.284	54.458
Std Err of Y Est	15.33[illegible]	16.159	21.214	12.953	16.112
R Squared	0.0374	0.0181	0.0418	0.0049	0.0045
No. of Observations	[illegible]	[illegible]	[illegible]	18	[illegible]
Degrees of Freedom	16	16	16	16	16
X Coefficient(s	-0.829	-0.837	-0.881	0.1691	-0.228
Std Err of Coef.	0.7690	0.7999	1.0532	0.6411	0.7978

TREND ANALYSIS: SNOW DEPTH
Fort Smith A (All Data)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	42.322	54.338	41.267	23.041	28.919
Std Err of Y Est	14.334	14.894	17.471	9.6343	11.522
R Squared	0.0044	0.0023	0.0001	0.0029	0.0068
No. of Observations	41	41	40	41	40
Degrees of Freedom	39	39	38	39	38
X Coefficient(s)	0.0769	-0.058	0.0127	-0.043	0.0774
Std Err of Coef.	0.1896	0.1939	0.2353	0.1271	0.1539

Fort Smith A (1971-)

Constant	30.382	41.463	75.586	51.661	87.754
Std Err of Y Est	11.450	11.464	14.342	10.496	7.2185
R Squared	0.0037	0.0025	0.0219	0.0374	0.0895
No. of Observations	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15
X Coefficient(s)	0.2058	0.1122	-0.411	-0.397	-0.421
Std Err of Coef.	0.5662	0.5675	0.7100	0.5197	0.3573

TREND ANALYSIS: SNOW DEPTH
Hay River A (All Data)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	105.74	114.13	61.653	49.506	78.941
Std Err of Y Est	19.748	18.765	22.542	16.165	18.609
R Squared	0.1756	0.1963	0.0106	0.0621	0.1192
No. of Observations	37	37	37	37	37
Degrees of Freedom	35	35	35	35	35
X Coefficient(s)	-0.630	-0.844	-0.215	-0.379	-0.623
Std Err of Coef.	0.3040	0.2889	0.3471	0.2489	0.2864

Hay River A (1971-)

Constant	21.195	28.171	-0.941	34.270	66.262
Std Err of Y Est	12.758	15.227	21.079	11.051	12.955
R Squared	0.0065	0.0051	0.0007	0.0087	0.0771
No. of Observations	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15
X Coefficient(s)	0.1985	0.2107	0.5662	-0.196	-0.716
Std Err of Coef.	0.8316	0.7538	1.0435	0.547	0.6414

TREND ANALYSIS: SNOW DEPTH
High Level A (1971-)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	64.5	103.22	70.259	26.383	61.309
Std Err of Y Est	18.945	19.546	23.573	11.322	15.923
R Squared	0.0097	0.0302	0.0105	0.0012	0.0121
No. of Observations	17	17	17	16	17
Degrees of Freedom	15	15	15	14	15
X Coefficient(s)	-0.264	-0.661	-0.465	-0.079	-0.338
Std Err of Coef.	0.6904	0.9676	1.1870	0.5902	0.7883

TREND ANALYSIS: SNOW DEPTH
Inuvik A (All Data)

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	84.593	77.391	93.778	86.301	33.513	36.402	78.929
Std Err of Y Est	17.030	14.288	15.618	20.024	14.075	14.983	14.740
R Squared	0.0457	0.0269	0.0572	0.0444	0.0111	0.0005	0.0777
No. of Observations	30	30	30	30	30	29	30
Degrees of Freedom	28	28	28	28	28	27	28
X Coefficient(s)	-0.418	-0.265	-0.429	-0.482	-0.166	-0.039	-0.477
Std Err of Coef.	0.3592	0.3014	0.3294	0.4223	0.2968	0.3332	0.3109

Inuvik A (1971-)

Constant	126.55	102.48	145.34	59.735	130.81	135.29	138.83
Std Err of Y Est	16.045	16.476	17.882	22.732	14.894	17.795	17.375
R Squared	0.0852	0.0319	0.0880	0.0046	0.1677	0.1195	0.1183
No. of Observations	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15
X Coefficient s	-0.938	-0.573	-1.286	-0.167	-1.382	-1.257	-1.220
Std Err of Coef.	0.8833	0.8157	0.9845	1.1746	0.7423	0.8811	0.8653

TREND ANALYSIS: SNOW DEPTH
Komakuk Beach A (All Data)

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	22.918	24.488	24.488	26.518	-7.818	-9.664	-2.911
Std Err of Y Est	11.542	10.881	10.881	10.192	11.280	10.820	9.2039
R Squared	0.0000	0.0002	0.0002	0.0010	0.0412	0.0694	0.2661
No. of Observations	27	27	27	27	27	26	27
Degrees of Freedom	25	25	25	25	25	24	25
X Coefficient(s)	-0.010	0.0213	0.0213	-0.047	0.2912	0.3528	0.3009
Std Err of Coef.	0.2852	0.2614	0.2614	0.2516	0.2606	0.2700	0.2261

Komakuk Beach A (1971-)

Constant	-43.00	-28.81	-30.42	-21.97	-8.051	-32.16	-56.46
Std Err of Y Est	10.709	9.1660	10.091	8.7599	13.618	11.777	10.078
R Squared	0.1884	0.1285	0.1181	0.0396	0.0187	0.0787	0.2006
No. of Observations	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15
X Coefficients	0.6181	0.6784	0.7063	0.5565	0.3014	0.6372	0.9661
Std Err of Coef.	0.5502	0.4547	0.4995	0.4338	0.6742	0.5830	0.4989

TREND ANALYSIS: SNOW DEPTH
Norman Wells A (All Data)

Regression Output:	JAN	FEB	MAR	APR	NOV	DEC
Constant	116.15	157.16	183.15	75.676	51.306	87.912
Std Err of Y Est	21.900	26.753	28.603	21.900	11.802	15.765
R Squared	0.2269	0.3052	0.3024	0.1692	0.1358	0.2431
No. of Observations	41	41	41	41	41	41
Degrees of Freedom	39	39	39	39	39	39
X Coefficient(s)	-0.978	-1.461	-1.552	-0.768	-0.385	-0.736
Std Err of Coef.	0.2890	0.3531	0.3775	0.2890	0.1557	0.2080

Norman Wells A (1971-)

Constant	289.11	336.74	366.13	169.42	89.259	152.74
Std Err of Y Est	15.991	19.622	14.79	19.842	8.6874	10.413
R Squared	0.4778	0.6553	0.6676	0.2021	0.3252	0.5915
No. of Observations	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15
X Coefficient(s)	-2.924	-3.782	-4.019	-1.881	-0.877	-1.666
Std Err of Coef.	0.7301	0.8961	0.7535	0.9059	0.3964	0.4753

TREND ANALYSIS: SNOW DEPTH
Shingle Point A (All Data

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	-24.83	-33.87	-21.75	21.023	-4.344	-10.87	-42.04
Std Err of Y Est	15.271	15.388	15.211	15.455	10.254	14.371	12.888
R Squared	0.2231	0.1913	0.1511	0.0014	0.0065	0.0977	0.3138
No. of Observations	28	28	27	28	28	28	28
Degrees of Freedom	26	26	25	26	26	26	27
X Coefficient(s)	0.8423	0.8289	0.7085	0.0471	0.3128	0.5452	0.9832
Std Err of Coef.	0.3081	0.3871	0.3847	0.4312	0.2245	0.3448	0.2774

Shingle Point A (1971-)

Constant	-183.6	-101.3	-133.8	-70.38	12.852	-24.19	-79.95
Std Err of Y Est	11.018	14.325	14.946	15.717	10.052	17.434	14.951
R Squared	0.5702	0.2875	0.3473	0.1031	0.0028	0.0401	0.2011
No. of Observations	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15
X Coefficient(s)	2.4335	1.6593	2.0908	1.1813	0.1029	0.6635	1.4367
Std Err of Coef.	0.5454	0.7092	0.7399	0.7781	0.4931	0.8631	0.7401

TREND ANALYSIS: SNOW DEPTH
Tuktoyaktuk (All Data)

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	11.625	20.838	16.447	10.625	13.726	10.960	14.247
Std Err of Y Est	12.097	13.646	15.171	17.370	8.6756	8.9620	9.7287
R Squared	0.0222	0.0069	0.0118	0.0157	0.0000	0.0132	0.0126
No. of Observations	30	30	30	30	30	30	30
Degrees of Freedom	28	28	28	28	28	28	28
X Coefficient(s)	0.2037	0.1263	0.1850	0.2451	-0.002	0.1161	0.1230
Std Err of Coef.	0.2551	0.2876	0.3200	0.3663	0.1829	0.1890	0.2052

Tuktoyaktuk (1971-

Constant	93.838	114.70	128.40	101.87	47.193	83.144	81.612
Std Err of Y Est	13.486	14.819	18.241	19.429	9.2818	9.7117	11.342
R Squared	0.0044	0.0214	0.1429	0.0525	0.0513	0.1462	0.1487
No. of Observations	17	17	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15	15	15
X Coefficient(s)	-0.818	-1.034	-1.760	-0.877	-0.474	-0.776	-0.485
Std Err of Coef.	0.8171	0.7202	0.7545	0.9613	0.4595	0.4823	0.5616

TREND ANALYSIS: SNOW DEPTH
Tungsten (1971-

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	-152.2	-128.4	-0.724	-242.2	31.683	112.85	230.81
Std Err of Y Est	29.426	33.515	33.451	46.611	16.416	22.933	34.167
R Squared	0.1618	0.0274	0.0402	0.1251	0.0003	0.0376	0.0695
No. of Observations	12	11	12	12	12	12	11
Degrees of Freedom	10	9	10	10	10	10	9
X Coefficient(s)	2.9648	2.5191	1.2792	3.5761	-0.067	-0.792	-2.014
Std Err of Coef.	2.1352	1.6096	1.9768	2.9901	0.9093	1.2833	2.4742

TREND ANALYSIS: SNOW DEPTH
Wrigley A (All Data)

Regression Output:	JAN	FEB	MAR	APR	OCT	NOV	DEC
Constant	70.290	109.22	132.08	18.925	8.8696	33.231	51.434
Std Err of Y Est	20.885	26.739	30.795	26.435	12.113	13.979	17.841
R Squared	0.0128	0.0508	0.0924	0.0005	0.0062	0.0058	0.0118
No. of Observations	24	26	26	27	27	30	26
Degrees of Freedom	22	26	24	25	25	28	24
X Coefficient(s)	-0.248	-0.700	-1.070	0.0715	0.1158	-0.112	-0.185
Std Err of Coef.	0.4639	0.5933	0.6844	0.6044	0.2544	0.2759	0.3443

Wrigley A (1971-)

Constant	222.77	215.19	410.66	153.03	135.94	127.81	167.59
Std Err of Y Est	16.564	13.214	14.388	22.382	14.071	16.715	16.933
R Squared	0.2411	0.5246	0.6067	0.0744	0.1602	0.0968	0.2901
No. of Observations	9	9	10	11	10	12	8
Degrees of Freedom	7	7	8	9	8	10	6
X Coefficient(s)	-2.265	-3.457	-4.817	-1.830	-1.331	-1.365	-1.928
Std Err of Coef.	1.5136	1.2474	1.3713	1.9868	1.2394	1.0992	1.2212

TREND ANALYSIS: SNOW DEPTH
Yellowknife A (All Data)

Regression Output:	JAN	FEB	MAR	NOV	DEC
Constant	71.464	70.980	84.841	34.195	52.488
Std Err of Y Est	13.597	14.397	16.328	9.5922	11.982
R Squared	0.1524	0.0985	0.0979	0.0403	0.0955
No. of Observations	35	35	36	35	35
Degrees of Freedom	33	33	34	33	33
X Coefficient(s)	-0.543	-0.448	-0.245	-0.185	-0.344
Std Err of Coef.	0.2228	0.2360	0.2510	0.1572	0.1960

Yellowknife A (1971-)

Constant	131.84	101.24	142.50	101.75	113.56
Std Err of Y Est	13.382	12.669	13.694	9.7434	12.652
R Squared	0.1942	0.0960	0.2049	0.2277	0.1662
No. of Observations	17	17	17	17	17
Degrees of Freedom	15	15	15	15	15
X Coefficient(s)	-1.259	-0.791	-1.333	-1.014	-1.063
Std Err of Coef.	0.6625	0.6272	0.6779	0.4828	0.6263

APPENDIX 6: STATISTICS OF TREND ANALYSIS OF FROST INDEX

TREND ANALYSIS OF FROST INDEX

FORT CHIPEWYAN A (1968-)

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.178434	0.398564
Std Err of Y Est	0.080657	0.120769
R Squared	0.000850	0.046797
No. of Observations	13	13
Degrees of Freedom	11	11
X Coefficient(s)	0.000481	0.005470
Std Err of Coef.	0.004971	0.007443

FORT RESOLUTION A

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.323724	1.077449
Std Err of Y Est	0.087679	0.102407
R Squared	0.004786	0.020126
No. of Observations	24	24
Degrees of Freedom	22	22
X Coefficient(s)	0.000802	-0.00193
Std Err of Coef.	0.002467	0.002882

FORT SIMPSON A

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.805612	1.189958
Std Err of Y Est	0.090845	0.103847
R Squared	0.215640	0.123320
No. of Observations	23	23
Degrees of Freedom	21	21
X Coefficient(s)	-0.00647	-0.00529
Std Err of Coef.	0.002693	0.003079

FORT SMITH A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.585753	1.329611
Std Err of Y Est	0.093874	0.122501
R Squared	0.263857	0.273456
No. of Observations	38	38
Degrees of Freedom	36	36
X Coefficient(s)	-0.00466	-0.00624
Std Err of Coef.	0.001299	0.001695

POST-1970

Constant	1.860718	1.634614
Std Err of Y Est	0.112072	0.153162
R Squared	0.144478	0.122086
No. of Observations	18	18
Degrees of Freedom	16	16
X Coefficient(s)	-0.00816	-0.01013
Std Err of Coef.	0.004969	0.006792

HAY RIVER A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.544701	0.908253
Std Err of Y Est	0.102621	0.120386
R Squared	0.108306	0.000040
No. of Observations	35	35
Degrees of Freedom	33	33
X Coefficient(s)	-0.00327	-0.00007
Std Err of Coef.	0.001633	0.001916

POST-1970

Constant	1.686156	1.736442
Std Err of Y Est	0.119875	0.119034
R Squared	0.048080	0.172984
No. of Observations	17	17
Degrees of Freedom	15	15
X Coefficient(s)	-0.00516	-0.01043
Std Err of Coef.	0.005934	0.005893

HIGH LEVEL A

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.448803	1.196230
Std Err of Y Est	0.104130	0.137309
R Squared	0.045419	0.093357
No. of Observations	16	16
Degrees of Freedom	14	14
X Coefficient(s)	-0.00420	-0.00816
Std Err of Coef.	0.005155	0.006797

INUVIK A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	2.463459	1.313289
Std Err of Y Est	0.159200	0.210229
R Squared	0.067383	0.000000
No. of Observations	28	28
Degrees of Freedom	26	26
X Coefficient(s)	-0.00510	0.000018
Std Err of Coef.	0.003724	0.004918

POST-1970

Constant	2.341739	0.582492
Std Err of Y Est	0.183850	0.224820
R Squared	0.010423	0.041638
No. of Observations	17	17
Degrees of Freedom	15	15
X Coefficient(s)	-0.00361	0.008985
Std Err of Coef.	0.009101	0.011130

KOMAKUK A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	2.365491	3.494851
Std Err of Y Est	0.513561	0.505237
R Squared	0.019036	0.010277
No. of Observations	17	17
Degrees of Freedom	15	15
X Coefficient(s)	0.012242	-0.00881
Std Err of Coef.	0.022691	0.022323

POST-1970

Constant	3.386005	5.952443
Std Err of Y Est	0.588440	0.569676
R Squared	0.000035	0.071500
No. of Observations	12	12
Degrees of Freedom	10	10
X Coefficient(s)	-0.00089	-0.04016
Std Err of Coef.	0.047277	0.045769

NORMAN WELLS A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.752301	0.612336
Std Err of Y Est	0.092759	0.137599
R Squared	0.136976	0.258001
No. of Observations	39	39
Degrees of Freedom	37	37
X Coefficient(s)	-0.00305	0.006699
Std Err of Coef.	0.001259	0.001867

POST-1970

Constant	1.831769	-0.39770
Std Err of Y Est	0.113593	0.103828
R Squared	0.037369	0.508626
No. of Observations	16	16
Degrees of Freedom	14	14
X Coefficient(s)	-0.00414	0.019567
Std Err of Coef.	0.005623	0.005140

SHINGLE POINT A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	3.165871	3.569418
Std Err of Y Est	0.325488	0.311020
R Squared	0.018249	0.100927
No. of Observations	17	17
Degrees of Freedom	15	15
X Coefficient(s)	-0.00804	-0.01888
Std Err of Coef.	0.015226	0.014549

POST-1970

Constant	4.045857	6.075699
Std Err of Y Est	0.372622	0.320034
R Squared	0.040569	0.283672
No. of Observations	12	12
Degrees of Freedom	10	10
X Coefficient(s)	-0.01946	-0.05116
Std Err of Coef.	0.029937	0.025712

TUKTOYAKTUK

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	3.222751	3.242876
Std Err of Y Est	0.343792	0.335306
R Squared	0.040516	0.104178
No. of Observations	24	24
Degrees of Freedom	22	22
X Coefficient(s)	-0.00931	-0.01507
Std Err of Coef.	0.009666	0.009427

POST-1970

Constant	3.248396	2.992309
Std Err of Y Est	0.381254	0.382460
R Squared	0.010350	0.015782
No. of Observations	13	13
Degrees of Freedom	11	11
X Coefficient(s)	-0.00958	-0.01190
Std Err of Coef.	0.028260	0.028349

YELLOWKNIFE A

ENTIRE PERIOD OF RECORD

Regression Output:	TEMP ONLY	TEMP & SNOW
Constant	1.833678	1.302127
Std Err of Y Est	0.106984	0.121744
R Squared	0.165109	0.015738
No. of Observations	31	31
Degrees of Freedom	29	29
X Coefficient(s)	-0.00514	-0.00166
Std Err of Coef.	0.002148	0.002444

POST-1970

Constant	1.612092	0.573533
Std Err of Y Est	0.130593	0.128078
R Squared	0.009296	0.079344
No. of Observations	17	17
Degrees of Freedom	15	15
X Coefficient(s)	-0.00242	0.007209
Std Err of Coef.	0.006465	0.006340